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REHABILITATION IN THE ROYAL AIR FORCE*

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An air gunner was admitted to a civilian orthopaedic hospital in November, 1940, for the treatment of a torn and displaced semilunar cartilage. In August, 1941, no less than ten months after admission, he was still in hospital and still totally incapacitated. Why was recovery so long delayed? What possible explanation could there be? The diagnosis had been correctly made and a skilful operation performed. The wound had healed by first intention; there was no infection, arthritis, or surgical complication. Daily massage had been continued, but the muscles were still wasted and weak. Two manipulations had been performed under anaesthesia, but movement was only half of normal. The gait was slow and hesitant; he limped; he could not run—he had never tried to run. The medical officer blamed him because "he would not co-operate," because he was disinterested, depressed, and resentful. He was certainly depressed, for after ten months the incapacity was more complete than on the day of admission. He was disinterested because, in his own words, "nobody takes any notice, and it looks as if it is hopeless." He was resentful because he could not believe that the fault was his. Had he not been told that "the nerve to his knee was cut"?

He was transferred to one of the orthopaedic rehabilitation centres of the R.A.F. Medical Service. He saw the sky, the sea, the open spaces. For many months he had seen only the stone walls of hospital wards, the stone walls of massage rooms, the stone walls of many corridors. In his new surroundings there was a lounge and writing-room; there were tasteful decorations and flowers, a varied menu, and an atmosphere of well-being and contentment. After a few days he smiled. There was sometimes a sparkle in his eye. He sensed a spirit of optimism and was reassured. His difficulties were explained, and he was taught special exercises. He learned to walk and then to run. He became an enthusiast and worked in the gymnasium, played on the fields, swam in the pool, cycled on the track. In the evenings he attended lectures and concerts, or played billiards and table-tennis. Time raced past, for he was busy. He became bronzed and fit. He laughed and was full of the joy of life. In seven weeks he returned to his unit and to full duty. The "nerve in his knee" was forgotten.

Ten months—total incapacity; seven weeks—full recovery: that is the story of rehabilitation in one air gunner. But is this an isolated case from which no conclusion should be drawn? The answer lies in the records of industry, the files of insurance companies, the experiences of H. E. Moore[1], the investigations of the B.M.A. Committee on Fractures[2 9], the findings of the Trades Union Congress[5], the reports of the Interdepartmental Committee on Rehabilitation[10], the publications of the Fabian Society[12], the reports of the Council for the Care of Cripples[11], the analyses of H. E. Griffiths[8], the papers of Kessler[3], Middleton,[4] Watson-Jones[1 5 6], Cunningham[7], Levy[12], Nicoll[13], Houlding[14], Malkin[15], and others. These records show that the experience of the air gunner is typical of many patients. In this country, at this moment, there are hundreds of injured men whose surgical treatment was concluded months ago but whose incapacity is still total because minor disuse-changes remain, or because confidence is lacking and morale has been destroyed. Their bodies have been treated, but not their minds. Treatment has been concentrated on the repair of bone and not on the tone and volume of muscles, stability of joints, circulation of limbs, control of oedema, and relief of adhesions. There have been no measurement and graduation of physical activity, no continuation of treatment until the patient recognized for himself that recovery was complete. It has been assumed that union of a fracture was followed promptly by the return of full function, and that when a man left hospital he soon returned to work. But now that members of the Services may not be discharged to out-patients and lost sight of, it is found that a simple cartilage operation may cause more than ten months' incapacity. We have known that a Colles fracture is united in six weeks, but not that this injury may keep a man off work for six months. We knew that fractures of the ankle were healed in twelve weeks, but not that they often incapacitated workmen for twelve months. We never conceived that in one series of 276 men there could be a wastage of no less than 168 working years[2], and that stiffness, swelling, weakness, and wasting may appear insuperable difficulties to many patients who, being inexperienced, fear that the weakness may be permanent, are terrified of normal strains and hazards, are overwhelmed by the prospect of work, and express their fears in the symptoms of "neurasthenia" and "malingering."

In December, 1937, the British Medical Association and the Trades Union Congress[5], in reporting these facts, recommended the development of rehabilitation services, including (*a*) functional treatment in hospital wards by regular exercises; (*b*) treatment in rehabilitation centres by physical and recreational activities designed to overcome residual disuse-changes, restore the confidence of patients in their recovery, and bridge the gap between the exercises of a fracture ward and the stresses of normal work; and (*c*) vocational retraining for the small proportion of men whose disability is permanent. These recommendations have not yet been generally adopted. In a report recently published[16] it is regretted that "the country does not as yet possess a comprehensive rehabilitation service." Of the civilian needs of the country it must be admitted that

* An address to the Council for the Development of Orthopaedics in Northern Ireland, delivered in Queen's University, Belfast, September, 1941.

this is true. But there is now evidence of an increasing appreciation of the importance of rehabilitation and of many attempts to introduce this treatment. In the Royal Air Force a comprehensive rehabilitation service has been in existence for two years, serving the needs of R.A.F. hospitals throughout the country, for the treatment of injuries sustained by a large number of men engaged not only in flying and operational duties but also in many forms of industry. The experience now available has very largely confirmed the opinions provisionally submitted some four years ago to the British Medical Association, the Trades Union Congress, and the Interdepartmental Committee on Rehabilitation. It has proved the value of organized treatment in the wards, the undoubted value of rehabilitation centres remote from fracture hospitals, the importance of patients living in the centres, the necessity for swimming-pools, playing-fields, and open spaces, the vital significance of creating the right atmosphere, the need for individual supervision of treatment by medical officers, the smaller part to be played by physical training instructors, the impossibility of one medical officer treating more than fifty patients, the unimportance of remedial workshops, and the limited value of occupational therapy and physiotherapy. Experience has proved that it is difficult and often impossible to fulfil the requirements within the grounds and buildings of a hospital, and that a rehabilitation centre without the right atmosphere is almost worse than no rehabilitation centre at all. A spirit of optimism, an atmosphere of enthusiasm, varied and continuous activities, and individual treatment by medical officers of the right type —these have proved to be the secrets of success.

Rehabilitation in Hospital Wards

The object of functional treatment is not only to cure but also to prevent muscle-wasting, joint stiffness, and other disuse-changes. The treatment must begin early, and certainly in the hospital wards, where every single patient has at least one special exercise to perform. The man with the fractured forearm exercises his fingers and shoulder. The patient with the fractured tibia mobilizes his toes and maintains the tone of his thigh muscles. Every patient with a lower limb in plaster practises quadriceps-muscle drill, even if the plaster extends up to the groin or over the hip-joint and trunk. The man with a fractured spine immobilized in plaster turns on his face and develops the erector spinae. Every patient with a disability of the knee-joint is taught thigh-muscle exercises before operation, and practises them immediately afterwards. Limbs which are not injured are also exercised, in order to promote general fitness and to reduce the difficulties which arise when the man leaves his bed.

Exercise Leaders.—If the exercise is to be of value it must be repeated over and over again, practised hour by hour, and continued persistently despite boredom and weariness. Rehabilitation does not begin with recreation and games ; it begins with work, and very hard work. It was found that an enthusiastic surgeon could change the spirit of a ward from one of complete lethargy and despair to one of some activity and life, but it was impossible for him to maintain sufficient continuity and persistence of activity. He was often engaged in the operating theatre, plaster room, out-patient department, or elsewhere. A trial was made of appointing one patient as the exercise leader. At every hour of the day he called his colleagues to attention, and supervised five minutes of special exercise. One sergeant pilot, for example, with two fractured arms, two burnt hands, and ten burnt fingers, inspired others by his own efforts and proved a most successful leader. But patients selected for eagerness and enthusiasm were often the first to recover and pass on ; moreover, there was no uniformity in their qualities of leadership. The final solution, which has proved to be of the utmost value, was the posting to every fracture ward of a specially trained full-time rehabilitation orderly.

Rehabilitation Orderlies.—Groups of nursing orderlies chosen for their enthusiasm and drive, and for the respect they would command by former achievements in games and recreations, were trained in the principles of fracture treatment, given experience in rehabilitation centres, taught the details of active exercises, warned of the dangers of passive stretching, and finally posted, not as masseurs, not as quack practitioners, but as rehabilitation orderlies. The duty of the orderly is to supervise all physical and recreational activities. Under the instruction of the medical officer he teaches every patient his special exercise, insists on hourly repetition throughout the day, coaxing, urging, and goading as may be required, always exercising patience and good humour. Patients call him the "muscle mechanic." He teaches them to walk in plaster, correcting the limp which so quickly becomes ingrained, weaning men from sticks and crutches, and aiming within a few days at a gait which, despite the handicap of plaster, is indistinguishable from normal. Many weeks and even months of disability may be avoided by preventing habit limps from becoming established and teaching men to walk confidently without the aid of sticks. The secondary duty of the orderly is to organize occasional general respiratory, trunk, and limb exercises, promote carpet-making, needlework, and similar activities, encourage wireless observers in Morse-tapping communication across the ward, introduce darts, tenniquoits, and billiards in recreation rooms, arrange simple games in the hospital grounds, and generally promote an atmosphere of enthusiasm. This duty is, however, of secondary importance. Recreational therapy, occupational therapy, and the therapy of intellectual pursuits are valuable in preventing depression and despair, but can never supplant the need for deliberate hard work. The dominant note of treatment must be exercise, not recreation.

Treatment in Rehabilitation Centres

When the fracture has united and the plaster is removed muscle redevelopment must be accelerated and intensified. This might be achieved in any hospital department or gymnasium by static exercises ; but greater interest and enthusiasm, and therefore more rapid progress, can be secured by the exercises of movement—running, skipping, cycling, swimming. Consequently it is an advantage from the purely physical point of view that treatment should be completed where there are playing-fields and swimming-pools, squash rackets and tennis courts, bowling-greens and croquet lawns. But there are more subtle reasons for the development of rehabilitation centres remote from general hospitals. The patient whose infected compound fracture has been treated for many weeks or months is satiated with hospital routine. The open air and a change of surroundings are no less important in his convalescence than good food and recreational activities. Moreover, the average man who lies in bed for many weeks, asking for this, ordering that, and commanding the other, becomes the king of a little universe which revolves around him. Here lies the germ of chronic invalidism, and both discipline and a new mode of life are necessary. Finally, nothing can be more certain than that patients whose injuries have been complicated by fears and depressions must be inspired by a new spirit of optimism and enthusiasm, and that complete removal from the hospital atmosphere is imperative. Every patient, no matter what his type, derives benefit when treatment is concluded in a special rehabilitation centre.

Continuity of Treatment.—The R.A.F. Medical Service had adopted this policy. With the exception of patients with less severe injuries, who can return direct to their units, all are transferred to rehabilitation centres when surgical stability has been reached—wounds being healed, new unpadded plasters applied, the position of fragments finally and accurately adjusted, and the union of fractures taking place. *X*-ray facilities in or near the rehabilitation unit are obviously necessary, and a plaster theatre is also needed for changes of plaster and minor manipu-

lations. But the centre must not become another hospital, and for all major surgical procedures the patient is referred back to the original hospital. Although geographically apart, the fracture unit and the rehabilitation unit are not functionally separated, and there has been no evidence of lack of "continuity of treatment" or imperfect "unity of control." Patients arrive at the rehabilitation centre with a sealed envelope enclosing a complete clinical record, with prints of relevant radiographs, clinical photographs, and detailed notes. At the centre there is a V.A.D. clinical secretary, trained on the same lines as the secretary at the fracture hospital, and also a radiographic printer. The notes are continued, later *x*-ray prints are incorporated, and, if further treatment at the parent hospital is needed, the up-to-date clinical record accompanies the patient once more. Continuity is also maintained by interchange of medical officers and by regular visits of consultants from the fracture hospital to the rehabilitation centre.

Special Rehabilitation Centres.—The needs of many general hospitals are served by a smaller number of rehabilitation centres. Special centres are available for officers, for air crews, and for skilled technicians, but no attempt has been made to provide a different centre for each industrial activity. It has been suggested that the Crewe railwaymen's centre, the Mansfield miners' centre, and the Greenwich seamen's centre implied the need for special centres for each type of industrial activity, but this is not so. The same exercises, the same recreations, the same atmosphere, apply to the treatment of every case, and the only variation which is needed in accordance with the particular physical requirements of each industry is in the duration of treatment.

Location of Rehabilitation Centres.—The centres in which the necessary atmosphere has been most easily created are those developed in the enclosed grounds and buildings of an evacuated boys' school and a hotel situated in the country, near the sand dunes and the sea but in reasonable proximity to the relaxations of pleasure resorts. The whole life of the patient must be controlled and adjusted, and this is possible only when sleeping-quarters, recreation rooms, gymnasium, playing-fields, and swimming-pool are included within a compact and self-contained unit. In one centre these amenities are scattered, and there has been clear evidence of loss of control. The patient who is most in need of discipline makes it his business to escape, and treatment has thereby suffered. In another centre the gymnasium and swimming-pool are one mile distant from the sleeping and recreational quarters, and the conditions are comparable to those of a non-residential centre where treatment is given only from 9 a.m. to 5 p.m. This difficulty has proved very great, and it has become clear that conditions can never be ideal unless patients are actually in residence and under whole-time supervision.

Number of Patients under One Medical Officer.—Treatment must of necessity be given by a medical officer and not simply by a physical training instructor. It is true that in the later stages of recovery group exercises and games can be supervised by an instructor; but in the earlier stages a patient who is timid and fearful must have supreme confidence in the surgical judgment of his adviser. A physical training instructor is not in a position to reassure a patient that certain symptoms may be ignored and that activity should continue despite discomfort. This reassurance is needed at the moment that symptoms arise, and not once or twice a week on the occasion of routine medical inspections. The medical officer must actually work in the gymnasium side by side with the patient, spending half an hour, an hour, or even several hours in the handling of one individual, becoming personally acquainted with him, searching for his particular difficulties, and dealing equally with psychological and physical handicaps. Obviously one medical officer cannot treat more than a limited number of men, and experience has shown that the maximum is in the region of 50. This was the original estimate in the B.M.A. report, and it is not an underestimate. When attempts were made to meet the shortage of medical officers by increasing the number to 75 or even 100 patients there was an immediate degeneration to mass treatment, and a loss of that intimate contact without which recovery cannot be accelerated. It is believed that even the number of 50 would have been too high if it had not been that every patient is admitted whether his psychological difficulty is great or small, that most are admitted while still in plaster and before functional disturbances are profound, and that they have usually come from hospitals where rehabilitation has already begun. It must also be remembered that if treatment is successful the rate of turnover is rapid and new patients are constantly arriving. The period of treatment ranges from only a few days up to six or eight weeks and the average is in the region of twenty-eight days. In all these circumstances the suggestion which has been made that one medical officer could deal with several hundred patients is very far indeed from the truth.

The Rehabilitation Team.—So far as limited man-power will permit, each group of 50 patients is treated by a team of one medical officer, one physical training instructor, and one masseuse, the members of the team having been selected for their personality and their ability to command respect and loyalty. The masseuse is engaged not only in electrotherapy and massage but also in the teaching of exercises and the correction of limp. The physical training instructors take group exercises, games in the gymnasium, marching and drill, medicine-ball, and similar activities. One of them is of particular value in teaching special exercise, because not only are his muscles superbly developed but he has an uncanny skill in the contraction of any muscle independently of all others—including, for example, one rectus abdominis, the serratus magnus, or the trapezius—a skill which fascinates and almost mesmerizes patients into emulating the expert. At each centre there is an organizer of games—a famous Davis Cup coach for officers and well-known professional footballers for the men. The medical officer is responsible for every activity which concerns his own group of patients, including all necessary surgical procedures such as changes of plaster, special clinical and *x*-ray tests, and manipulations under anaesthesia. Incidentally, valuable psychological information is often gained during the recovery of a patient from pentothal anaesthesia. Rehabilitation medical officers need not therefore be experienced operators, but they must be well grounded in the principles of orthopaedic and fracture treatment, the interpretation of *x*-ray films, the technique of plaster, and the art of manipulation. They have also been specially trained by Dr. H. E. Moore, the R.A.F. civilian adviser on rehabilitation, who worked with them day by day, imparting experience which cannot be conveyed by word or letter, but only by practice. Finally they have been encouraged to visit rehabilitation centres elsewhere, notably at Berry Hill, where Mr. Nicoll arranged a number of three-day demonstrations.

The Commanding Officer ("*Administrative Superintendent*").—If a rehabilitation centre is small enough, the medical officer may also be the medical superintendent. But it is economically sound from the point of view of amenities, and psychologically sound from the point of view of atmosphere, to treat many units of 50 patients under one administration. The commanding officer of the whole centre may be a medical man, but not necessarily so. He must, however, be a man of unusual qualities, inspiring in his leadership, good-humoured in his manner, and tireless in his zeal, a man who at one and the same time commands discipline and devotion. His duties include much more than simple administration; he has the power to create or to destroy the spirit which brings success.

Importance of a Large Gymnasium.—The most important item of equipment is a sufficiently large gymnasium, or for bigger centres more than one gymnasium. A vast covered space is required, so that individual exercises, pulley-and-weight activities, couch work, tuition in walking, gymnastics, hopping, skipping, and organized games can all be pursued simultaneously and under supervision. Concentrated work on individual muscles is, of course, no less essential in the rehabilitation centre than in the hospital ward. This was advocated by Nicoll[13], whose methods of controlling and graduating muscle contraction and recording muscle power have been used. But the boredom of one long day of activity must be relieved by limiting the duration of static exercises. There must be space for handball, badminton, skittles, quoits, and shuffle-board, and for wall bars, climbing ropes, punch-balls, bicycles, and rowing machines. At one centre the gymnasium space became unequal to the demand, and when movement and progress exercises became increasingly limited, enthusiasm rapidly waned. The smallest useful gymnasium should measure 60 feet by

30 feet, this sufficing for not more than 30 or 40 patients. The optimum size for 100 patients is in the region of 150 to 200 feet long by 70 feet wide, the considerable length being desirable so that many activities can take place side by side across the width of the room.

Massage, Examination Rooms, and Canteen.—Massage cubicles must open direct from the gymnasium or even be situated within it. It is unfortunate if there is an intervening corridor, and the development of a physiotherapy department some distance from the gymnasium is a serious mistake because it encourages the impression that physiotherapy and electrotherapy are independent and self-sufficient measures of treatment. Massage is not an end in itself; it is a means to the end of activity. The patient whose stiff joint has been baked in the massage room exercises it at once in the gymnasium; the patient in the gymnasium who complains of aching and discomfort withdraws for a period of massage; as the indications arise there is constant to-and-fro movement of patients. Paraffin-wax baths, whirlpool baths, radiant heat, and diathermy are all useful provided only that passive measures never take the place of active effort. Similarly, hot and cold showers and foot baths are important additions to the changing-room. The medical officer's examining room, where case sheets and radiographs are filed, should also open direct from the gymnasium. It must be easy for a medical officer to take a patient into his private room for two or three minutes' reassurance, firm handling, or stern criticism, as a simple incident in the course of the day's activity, and with none of the formality of routine inspections. Finally, space in the immediate proximity of the gymnasium should be devoted to the needs of occasional relaxation and refreshment at a canteen or milk bar.

Playing-fields and Swimming-pool.—The routine in one of the centres has been to devote mornings to work in the gymnasium and the swimming-pool and afternoons to croquet, golf, tennis, handball, and squash rackets, with occasional tournaments for the "nearly fit," and some for the "not-so-fit." But this programme has tended to encourage patients in the belief that the work of the day finishes at lunch-time, and special exercises are very often needed for much more than half the day. It is better that gymnasium and playing-field should each be used, both in the mornings and in the afternoons. Moreover, general recreations and games must be organized, and be closely related to the requirements of the individual. He may begin with "standing tennis" or bowls, and graduate through croquet or approach-putting to fives or squash rackets. A swimming-pool is invaluable, particularly for internal derangements of the knee-joint, for which muscles must be developed without weight-bearing strain. One pilot, for example, with an arthroplasty of the knee following infection and ankylosis of the joint, was able to mobilize and stabilize the surgically constructed joint by swimming long before he was fit for gymnastic activities. He succeeded in developing such strength and power of endurance that he is now engaged in transatlantic flights. Patients whose cartilages have been removed are expected to make a complete recovery and to be fit for every type of activity within five or six weeks of operation, an incapacity period which is in marked contrast with the average period when no rehabilitation centre and no swimming-pool are available. Cycling is another non-weight-bearing exercise of the greatest possible value in knee-joint cases. Through the aid of the Red Cross and St. John each rehabilitation centre has been provided with twenty bicycles, some fitted with a variable length of crank shaft by which to accommodate limited ranges of knee movement. One determined sergeant actually mounted his bicycle and took his place in the cycle-polo team despite the handicap of a full-length above-knee plaster.

Evening Recreations.—It might be assumed that after a strenuous day of controlled activities relaxation would be the rule in the evenings. But billiard tables are in constant demand, and men little realize how far they walk in their circuits of a billiard table. Table-tennis, darts, and other recreations are provided. One or two evenings of the week are devoted to dances, concerts, debates, and "brains-trust" meetings.

Occupational Therapy and Workshops.—The arts-and-crafts type of occupational therapy finds its greatest application in hospital wards, where there are many idle hours to fill. Simple workshop activities such as carpentry, fret-sawing, model aeroplane construction, and basket or rug making, are interesting additions to the amenities of a rehabilitation centre, particularly during the winter months, when outdoor activities are limited. But a remedial workshop is not a rehabilitation centre. Workshops, occupational-therapy benches, and massage cubicles are, like medicine-balls, climbing ropes, and skittles, items of equipment which are sometimes useful but never indispensable. At one R.A.F. centre where skilled technicians are treated, fully developed technical training workshops are available for use during part of the day, the rest of which is devoted to supervised gymnastic and recreational activities exactly as in other centres. The intention was that patients who are capable of ordinary work for limited periods should use the workshops and at the same time continue treatment. It was also intended that men might be tested from time to time under working conditions, in the same way that an air crew centre was equipped with a fuselage by which to test the physical ability of pilots. This combined rehabilitation centre and workshop is continuing experimentally, but it is by no means certain that any advantage has been gained over centres without workshops. The one fact that is clear above all others is that a workshop alone, with the clinical examination of patients once a week, is worthless. I have seen men dealt with in this way. I have seen them after six months. There can be no possible doubt that the danger of patients' being buried in a workshop is even more grave than the former danger of patients' being buried in a massage department.

Vocational Retraining

It has been argued that treatment in rehabilitation centres is unnecessary and wasteful because all injuries fall into one of two groups: (1) those from which full recovery is possible without rehabilitation, and (2) those which cause permanent disability despite rehabilitation. But no surgeon would advance this argument who had shared with me the experience of closely observing the recovery rate in a Service assisted by rehabilitation where 85% of injured men returned to full duty, and at the same time, week after week, of reporting upon scores of workmen who were totally incapacitated, and for many months had remained totally incapacitated, by the disabilities that are so rapidly cured in rehabilitation centres. But more than this, even in men whose disability is inevitably permanent, rehabilitation is an essential phase of treatment. Permanent total incapacity can often be reduced to permanent partial incapacity. Furthermore, it is almost impossible to assess the degree of permanent disability with any accuracy until a patient has been treated and observed in a rehabilitation centre. It then remains the final duty of the rehabilitation medical officer (or the liaison officer working with him) to make contact with the employer and arrange an alternative form of employment, or to make contact with a retraining centre where the man will learn a new trade. The Ministry of Aircraft Production has co-operated with the R.A.F. rehabilitation service and arranged for the immediate employment in a suitable trade of men who are necessarily invalided and, in doing so, has accepted the recommendation of rehabilitation medical officers who have precise knowledge of the injured man's physical capacity. The teaching of new trades to cripples and men incapacitated by injury has long been undertaken at Oswestry, Leatherhead, and Exeter, and the Ministry of Labour is now engaged in introducing a more ambitious scheme of retraining. It is to be trusted, however, that this phase of rehabilitation will not be accepted as the whole solution of the problem. Retraining is the smallest part of rehabilitation, and from the numerical point of view it is the least important. The complete rehabilitation service by which 85 to 90% of men can be restored to their former trades, and which even in the remaining 10 to 15% is an indispensable prelude to vocational retraining, must also be introduced.

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A CASE OF STAPHYLOCOCCUS ALBUS SEPTICAEMIA

WITH REACTIONS OF 150 STRAINS OF STAPHYLOCOCCI

BY

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It has long been realized that the pigment production of a particular strain of staphylococcus is not wholly reliable as a guide to its pathogenicity. Nevertheless, most laboratories are still content to report a staphylococcus as being albus, aureus, or citreus without further comment. The presence of a zone of haemolysis on a blood-agar plate has little or no significance. Soluble haemolysin production is fairly closely related to pathogenicity, but a reliable test entails growing the organism in an atmosphere containing about 20% carbon dioxide on a semi-solid medium and testing a filtrate of the resultant growth with rabbits' red cells. It is therefore too laborious to be used as a routine laboratory test. Loeb (1903-4) observed that certain strains of staphylococci were capable of clotting citrated plasma. This was also described by Much (1908), who emphasized the correlation of coagulase production and pathogenicity. More recently Cruickshank (1937) correlated coagulase production with fermentation reactions and haemolysin production, and found that the coagulase test was the one most closely related to pathogenicity for the rabbit. Chapman *et al.* (1934) compared haemolysin and coagulase tests as guides to pathogenicity in a large series of strains, and found that the coagulase-positive strains were usually pathogenic. Unfortunately their observations on haemolysis were confined to results obtained on blood-agar plates. In the following case of *Staph. albus* septicaemia no primary focus of infection was discovered, and the first positive finding was the blood culture. It therefore emphasized the need for some means of differentiating between a pathogenic *Staph. albus* and a saprophytic strain from the skin with which the blood culture might have been contaminated. In view of this I have thought it worth while to add to the description of this case a summary of the reactions of 150 strains of staphylococci derived from a variety of sources.

Case Report

The patient, a woman aged 52, was admitted to hospital on September 17, 1941, with a three-weeks history of febrile illness but no special symptoms. Six months previously her legs, up to the knees, had started to swell. The swelling persisted for five months and then passed off in a week, and on her admission was completely absent. On examination her temperature was 98.6° F., pulse 130, and respirations 22. She was flushed and sweating. The most conspicuous feature was skin lesions of an uncommon type. Nodules were present over the right deltoid, on the left upper arm, in the region of the left elbow, over the left hamstrings, in the right popliteal fossa, and on the buttocks. They ranged from 0.5 to 10 cm. in diameter, were dusky red to purple in colour, and a little warmer than the surrounding skin; some were slightly tender. They appeared to be involving the subcutaneous tissues. The teeth were carious, and there was gross pyorrhoea. The knee-jerks and ankle-jerks were absent; owing to the patient's mental confusion it was difficult to test for loss of sensation. Retention of urine was present, and this persisted. There was apparent neck rigidity, which at first suggested meningitis, but, as it later became clear, it was merely part of a general muscular tenderness and rigidity. No other significant physical signs were discovered. The urine contained albumin but was otherwise normal.

The patient ran a swinging temperature between 98° and 102° F. On September 18 a blood count showed: red cells, 5,000,000 per c.mm.; Hb, 80%; colour index, 0.8; white cells, 8,000—polymorphs 78%, lymphocytes 12%, monocytes 10%. The cerebrospinal fluid was under a pressure of 300 mm. but was otherwise normal. Blood cultures taken on September 18, 22, and 23 gave a pure growth of *Staph. albus*. On September 20 a biopsy of one of the cutaneous nodules showed it to consist of pyaemic abscesses of a somewhat chronic type, which contained colonies of staphylococci.

On September 20 oedema was observed over the sacrum, and there was ulceration of the cutaneous nodule over the right buttock. A blood count on the 25th showed that the haemoglobin had fallen to 66%, with 4,300,000 red cells and a colour index of 0.76; the white cells had risen to 24,000—neutrophils 89%, eosinophils 2%, lymphocytes 9%. On the 27th a sinus in the right buttock discharged a large quantity of pus. A culture of this gave a pure growth of *Staph. aureus*. The suppuration in this area increased very much, and on the 30th the abscess was widely incised and explored. A large loculated abscess cavity full of pus was found in the subcutaneous tissues, but no evidence of a more deep-rooted lesion, such as osteomyelitis of the sacrum, was detected.

The patient was given a course of sulphathiazole, a total dose of 50 gm. being taken between September 19 and October 4; but her general condition steadily deteriorated, the abscess over the right buttock and sacrum increased in size, and on October 23 she died.

Post-mortem Findings

In the skin and subcutaneous tissues were found multiple abscesses, many of which were healed. A very extensive and foul-smelling abscess was present over the sacrum. It communicated with sinuses in the buttocks and with the pelvic soft tissues, which were inflamed. Thick yellow pus was seen in the extradural space, with collections round the cauda equina. There was no intrathecal inflammation or any evidence of disease in the sacrum or coccyx.

The lungs showed a few small abscesses on both sides and bronchopneumonic consolidation of both bases. The heart was rather small and there was a single circumscribed abscess in the myocardium, but otherwise no gross abnormalities. The kidneys had numerous abscesses in the parenchyma and there was severe bilateral pyelitis. The ureters were double on both sides, the left arising from a double and the right from a single pelvis. They united on each side before entering the bladder, which showed a severe purulent cystitis. The spleen was not enlarged, but appeared rather firm and fleshy. The genitalia were normal except for a chronic cervicitis. No abnormality was seen in the liver or the brain.

Histological section showed that the abscesses were of a rather chronic type, and there was little or no evidence of inflammatory reaction in the surrounding tissues. They contained clumps of staphylococci, but not in very large numbers. The spleen was not grossly abnormal, but the granulocytes were increased. There was a slight excess of polymorphonuclear cells in the sinuses of the liver.

Bacteriological Findings

A pure culture of *Staph. albus* was isolated on three occasions from the blood; *Staph. aureus* was grown from the abscess over

the sacrum ; and from the lung abscesses post mortem an intermediate type was obtained.

Table I summarizes the reactions of the strains from the blood and the lung. The strain from the blood remained porcelain-white if grown on plain agar at 22° C. for a week or left at room temperature for many days, and even after passage through a rabbit. The strain from the lung produced a golden pigment when cultivated at 22° C. It will be seen that the strain from the blood, like that from the lung, was haemolytic to rabbits' red cells, was lethal to rabbits, and produced coagulase, so that the evidence of its being a pathogenic organism is fairly conclusive.

TABLE I.—*Reactions of Strains from Blood and Lung*

	Blood	Lung
Pigment production :		
Original culture at 37° C.	Albus	Albus
Later culture at 22° C.	,,	Aureus
Coagulase production	+	+
α-lysin production	+	+
Pathogenicity to rabbit	+	+
Fermentation of lactose	+	+
Fermentation of mannite	+	+
Fermentation of glucose	+	+
Fermentation of sucrose	+	+
Litmus milk	Acid (no clot)	Acid (no clot)
Liquefaction of gelatin	+	+
V.P.	+	+
M.R.	+	+

Alpha-lysin production was tested for by growing the organisms on 0.3% agar in an atmosphere containing 20% carbon dioxide for forty-four hours. The cultures were then centrifuged and the supernatant fluid was passed through a Seitz filter. The bacterium-free filtrate was set up in serial dilutions with equal volumes of a 2% suspension of rabbits' red cells in saline. The organism from the blood culture produced complete lysis in a dilution of 1 in 64, and that from the lung in a dilution of 1 in 32. The coagulase test was carried out as described by Fisk (1940).

Analysis of 150 Strains of Staphylococci from Various Sources

Table II summarizes the reactions of 150 strains of staphylococci, all isolated from material sent to this laboratory during the last few months ; 68 produced coagulase

TABLE II

Group	Pigment Production		Fermentation of		Coagulase Production	No. of Strains
	Original Cultures at 37° C.	Later Cultures at 22° C.	Lactose	Mannite		
I a	Aureus	Aureus	+	+	+	43
I b	,,	,,	−	+	+	3
I c	Albus	,,	+	+	+	19
I d	,,	Albus	+	+	+	3
II a	Albus	Albus	+	−	−	51
II b	,,	,,	−	−	−	7
II c	,,	,,	−	+	−	7
II d	,,	,,	+	+	−	11
II e	,,	Aureus	−	+	−	2
II f	Aureus	,,	+	−	−	2
III	Citreus	Citreus	−	−	−	2

and 82 did not. Of the 68 coagulase-positive strains (Group I) 46 were typical aureus, and these 46 all came from obvious sources of infection such as osteomyelitis, boils, carbuncles, infected wounds, etc., except one which came from a nasal swab ; 22 of the coagulase-positive strains were quite definitely porcelain-white on primary isolation at 37° C. even after leaving the plates at room temperature for one or two hours, but 19 of these produced an aureus pigment when grown at 22° C. or left at room temperature for several days. These 19 came from suppurative infections with two exceptions—one from a nasal swab and one from the vagina. Of the 3 true albus strains which produced coagulase, one came from the blood of the patient here reported ; one was obviously an albus variant of an aureus strain as it was isolated from a septic finger, the culture from which produced a large number of *Staph. aureus* colonies and a few albus ; and the third came from the urine of a patient suffering from *Staph. aureus* septicaemia who had previously had *Staph. aureus* in the urine.

With regard to the 82 coagulase-negative strains 76 were typical albus (Group II) and 2 were citreus (Group III). Of these 78 strains 63 were quite definitely not causing any infections, and 14 of these apparently saprophytic organisms fermented mannite ; 8 of the albus coagulase-negative strains were found in association with *Staph. aureus*, and one of these fermented mannite ; 7 appeared to be the cause of a urinary infection and 3 of these fermented mannite. Two strains which did not produce coagulase appeared to be aureus after cultivation at 22° C. and fermented mannite (Group II). They both seemed to be the cause of a urinary infection. Two coagulase-negative strains were aureus on primary isolation. Neither fermented mannite and neither appeared to be the cause of any infection.

Discussion

This case of staphylococcal septicaemia is unusual in that no primary focus of infection was discovered and that the organism isolated from the blood was *Staph. albus*. On admission the only evidences of infection were the temperature and the cutaneous nodules. Later, obvious suppuration developed in the region of the sacrum and right buttock and there was a leucocytosis. Previously the white cell count had been normal. In view of the neurological signs it is possible that the collections of pus round the cauda equina were present on admission. The primary source of infection may have been a small area of osteomyelitis in the sacrum or coccyx, but no evidence of this was found on *x*-ray examination or at necropsy. The cutaneous nodules are interesting, and the biopsy of one of them was a valuable means of confirming the diagnosis. McCrea (1940) describes a case of septicaemia and pyaemia following a carbuncle in which "multiple painful red papules about the size of a shilling" developed over the right tibia and one at the insertion of the deltoid muscle. Mendell (1939), in an article dealing with 35 cases of staphylococcal septicaemia from various causes, described 10 cases which developed multiple metastatic abscesses in the skin ; but I have not found a single recorded case in which, apart from pyrexia, cutaneous nodules were the sole evidence of infection. A man aged 48 was recently admitted to this hospital with *Staph. aureus* septicaemia, the primary focus probably being in the urinary tract. He developed a maculo-papular rash after admission, and the papules gradually increased in size to become slightly tender swellings in the skin and subcutaneous tissue. One of these was removed for histological section and showed a picture similar to that of the case described.

In the small series of staphylococci described not a single coagulase-negative strain was giving rise to infection outside the urinary tract, whereas 65 out of 68 coagulase-positive strains came from suppurative lesions, and 20 of these would have been reported as *Staph. albus* if only incubated at 37° C. All the pathogenic strains in this series fermented mannite, but many apparently saprophytic strains did too. The coagulase test is easily and quickly performed, and a four- to five-hour culture gives reliable results, so that if a single colony be subcultured into a tube of broth first thing in the morning, a few drops of the broth culture can be added to diluted plasma early the same afternoon. The test might therefore be used with advantage as a routine laboratory procedure.

Summary

A case of *Staph. albus* septicaemia in which no primary focus of infection was found is described.

A summary of the reactions of 150 strains of staphylococci is given, illustrating the value of the coagulase test as a means of differentiating between pathogenic and saprophytic strains.

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THE PRESENCE OF DIFFUSING FACTOR AMONG THE METABOLITES OF AEROBIC MICRO-ORGANISMS

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The presence of "diffusing factor" has been reported in: (i) mammalian testis extract (Hoffman and Duran-Reynals, 1931; McClean, 1930, 1931), (ii) snake and spider venom (Duran-Reynals, 1936), (iii) leech extract (Claude, 1937), (iv) malignant tumours (Boyland and McClean, 1935), as well as in cultures of the following micro-organisms: (v) staphylococcus (Duran-Reynals, 1933), (vi) streptococcus (Duran-Reynals, 1933), (vii) *Clostridium welchii* (McClean, 1936), (viii) *Cl. oedematis maligni* (*Vibrion septique*) (McClean, 1936), (ix) pneumococcus (McClean, 1936). Whether or not the diffusing activities evinced by these organisms and tissues are due to the same substance, or are even physiologically identical, cannot be stated with certainty, if only because the methods of test—to which we refer again below—have varied somewhat widely. We wish at the outset to make it clear that our references to "diffusing factor" and "diffusing activity" are to the substance that, in the simple but lucid definition of McClean and Morgan (1933), "dramatically increases the permeability of the skin to injected fluids and particles." All our tests, qualitative or quantitative, have been carried out by the procedure described elsewhere (Bacharach, Chance, and Middleton, 1940) for testicular diffusing factor (t.d.f.): the results of these tests are not necessarily the same as would have been obtained by different methods.

The presence of diffusing factor in bacterial cultures is of interest in itself to those investigating the metabolic processes of micro-organisms or applying the results of their work to medical practice, and has possible applications in therapy. Pharmacologically, diffusing factor appears to be inert: it has no effect on blood pressure (Christensen, 1938) and its action is not antagonized by histamine or adrenaline (Madinaveitia, 1939). Its injection into the cerebrospinal canal, however, markedly hastens the peri-axial spread of cerebrospinal fluid (Cohen and Davies, 1939). Apart from the possibility, to which considerable attention has been given by McClean (1941c), that diffusing factor produced by micro-organisms might affect their pathogenicity, there is also the question whether non-toxic preparations of the active substance might not be used as an adjunct in therapy—along with, for example, anaesthetics and narcotics, or in electrophoretic treatment—to reduce the quantities required for a given effect or the time required for an effect to be manifested.

Bound up with such considerations are the questions of the chemical nature and the specificity of diffusing factor. In some respects its properties are those of an enzyme system. Chain and Duthie (1939) found purified preparations of diffusing factor to possess marked mucolytic properties and suggested its identity with mucinase; but correlation between diffusing and mucolytic activity, whether this is determined by measuring the reduction in viscosity or in other ways, has not always been established. East, Madinaveitia, and Todd (1941) have recently shown that liberation of reducing substances does not go *pari passu* with reduction in viscosity, and suggest that two different enzymes may be involved: they have also demonstrated, by its action on β-phenyl-N-acetyl glucosaminide, the presence in testis extracts of an enzyme they call "β-glucosaminase," although it is admitted (Todd, personal communication) that "β-glucosaminidase" would be the more correct term. This enzyme is distinct from the substance (or complex) in the extract responsible for reducing the viscosity of hyaluronic acid. Robertson, Ropes, and Bauer (1940) examined preparations of *Cl. perfringens* and state that they hydrolysed mucoid (synovial fluid) in two stages: first there was a rapid decrease in viscosity, accompanied by a change in precipitability with aluminium hydroxide; then there was a gradual liberation of amino-sugars and reducing substances, reaching a maximum at twenty-four to twenty-eight hours. The work of Meyer and his colleagues (1941) suggests, on balance, a close correlation between diffusing activity and hyaluronidase content, as does the finding of McClean and Hale (1941) that the production of both hyaluronidase and diffusing activity by *Cl. welchii* or by streptococci is increased when these organisms are cultured in presence of hyaluronic acid. On the basis of existing knowledge it is not possible to say whether or not the increase in reducing power shown during the action of diffusing factor on mucoid is due wholly, or even in part, to the action of β-glucosaminidase. In any event, the relationship is not a simple one, and the matter must be considered still *sub judice*.

Unfortunately, lack of agreement as to the identity of diffusing factor even with a mucinase—or hyaluronidase, as most authors prefer to call it—and its differentiation from β-glucosaminidase have complicated the position, because different workers have been led to use different tests for the presence of diffusion-promoting substances. Apart from viscosimetric determinations and estimations of the amount of reducing substances liberated, a clot method has been described by McClean (1941b). In this the enzymic activity is measured by the extent to which, in the presence of acetic acid, the formation of a clot from mucoid is inhibited: there are also variants of the test on the skins of rabbits. Our method is based on the measurement of "blebs" produced in the skin of shaved rabbits after intradermal injection of the test solution. Full details have been published elsewhere (Bacharach, Chance, and Middleton, 1940), and it is here necessary only to indicate the quantitative limitations of the restricted tests reported below.

Between bleb areas of 4 and 7 sq. cm. the relationship between area and log dose is a linear one, these limiting values corresponding with about 0.4 and 2 of our units, respectively. Over this range the mean variance of an individual bleb was found to be 0.83. From this it follows that the means of three blebs differ from each other significantly at the 5% level when the difference exceeds 2 sq. cm.; with six blebs significance is established at the same level for differences of more than

* In this investigation Dr. Ungar had the assistance of N. McLeod and E. V. Welch; and Mr. Bacharach that of T. R. Middleton.

1.2 sq. cm. In these estimates the calculation of variance is based on the heterogeneous groups used in the experiments described by Bacharach *et al.* (1940)* ; this is certainly an overestimate when doses are distributed so as to counteract the effect of differences in sensitivity of different animals. A fairer estimate of variance can be calculated from the differences between replicate blebs produced by the same dose on one animal, and this estimate may be used in assessing the significance of the difference between mean values of bleb areas obtained under our conditions of test. Such a calculation shows that the means of two comparable groups of three blebs differ significantly (P=0.05) when the difference is greater than 0.57 sq. cm. for values below 4.5 sq. cm. ; the corresponding significant difference for values from 4.5 sq. cm. to 7 sq. cm. is 0.77, and for values above 7 sq. cm. 0.95 ; mean values above 8 are very seldom encountered. With six pairs of blebs the corresponding significant differences are 0.34, 0.44, and 0.55 sq. cm.

Consideration of these limits has led to the following scale of assessment, on the basis that the mean response at the mid-point of a grade should differ from that at the next by about twice the significant difference.

Class	3 Pairs of Blebs	6 Pairs of Blebs
0	Up to 4·5 sq. cm.	Up to 4 sq. cm.
±	4·5 to 6 sq. cm.	4 to 5·5 sq. cm.
++	6 to 7·7 sq. cm.	5·5 to 7·4 sq. cm.
+++	Over 7·7 sq. cm.	Over 7·4 sq. cm.

We have examined a considerable number of aerobic micro-organisms on this semi-quantitative basis. They include saprophytes and pathogens of toxigenic, non-toxigenic, invasive, and non-invasive types, different species of a common genus, different types or varieties of a common species, a typical yeast, several moulds, a certain number of toxin and toxoid preparations, and two samples of bacteriophage The yeast (*Saccharomyces cerevisiae*) and *Pseudomonas pyocyanea* were examined as specially active elaborators of cellular enzymes, which are found in their broth cultures, and bacteriophage because of its intense biological activity. At least two independent tests were almost always carried out on preparations from the same organism (strain, variety, etc.), so that the number of samples examined exceeds, sometimes considerably, the number of strains indicated in column 3 of Table I ; when there was any ambiguity, results were checked by further tests. In Tables II and III the figures in parentheses indicate the number of blebs from which the means have been calculated.

Our experiments have been designed to examine certain selected aspects of diffusing activity as shown by these bacterial cultures. Broadly, three matters have been investigated: (1) In the cultures of which micro-organisms can diffusing factor be detected? (2) At what time does diffusing factor appear in the cultures, and what is the relation between the amount of diffusing factor present in the medium and the amount of toxin and number of micro-organisms? (3) How does the influence of formalin and heat on diffusing factor compare with their effects on toxin production by the same micro-organisms?

Pathogenic micro-organisms develop their specific action in the infected host by local invasion with consecutive extensive tissue damage (e.g., anaerobic wound infection), by multiplying in the body of the host and causing fatal bacteriaemia (sepsis), or by producing at the place of the infection a toxin which affects a specific sensitive tissue of the body (diphtheria, tetanus). The virulence of the micro-organisms can be shown (to characterize it in simple terms) by their invasiveness or by their toxigenicity, which may be quite distinct properties. In some micro-organisms both those properties can coexist (as in septicaemia, pyaemia). The pathogenic action, whether toxigenic or invasive, is enhanced by substances produced in the active phase, such as fibrinolysins, coagulase, leucocidin, and other enzymes.

The question arises whether diffusing factor produced by pathogenic micro-organisms also acts as a factor in their pathogenic effect. We have therefore examined a range of aerobic micro-organisms for the presence of this factor in their cultures. We are aware of the limitation applying to conclusions drawn from effects observed *in vitro* ; all we claim is that these experiments give certain comparative information as to bacterial properties.

In Table I is arranged a list of the micro-organisms used, with an indication of the type of their pathogenic activities. Column 2 gives the description of the bacterial product tested ; column 3 indicates the number of strains of each species used ; and column 4 shows whether diffusing factor is present, with an indication as to its concentration. In column 5 the type of virulence of the micro-organisms is roughly indicated—i.e., their production of an exotoxin or their invasiveness.

TABLE I

Description of Micro-organism	Description of Substance	No. of Strains	Diffusing Activity	Properties of Micro-organism
1. Staph. pyogen., albus, aureus	Toxin grown on synth. agar	5	++ to +++	Virulent (toxigenic, invasive)
2. Str. pneumoniae Types I, II, III, IV	Filtrate of 48-hr. broth cult.	6	0 to ++	Virulent (invasive)
3. Str. scarlat. Types I, II, IV Griffith	Filtrate of 24-hr. broth cult.	4	+ to +++	Virulent (toxigenic, invasive)
4. Str. Group C haem.	,, ,,	2	+ to ++	Virulent (invasive)
5. Sac. cerevisiae	Filtrate of 48-hr. broth cult.	1	+++	—
6. Penicillium species	Filtrate Czapek's medium	3 1	— ++	—
7 Br. abortus Bang	Filtrate of serum broth	2	0	Virulent (invasive)
8. Br. melitensis	,, ,,	2	0	,, ,,
9. Str. scarlat. Type III Griffith	Filtrate of 24-hr. cult.	1	0	Virulent (toxigenic, invasive)
10. Mycobact. tuberculosis, human type	Filtrate of glycer. liver broth cult.	1	0	Virulent
11. Cor. diph. mitis, intermed., gravis	Toxin grown on broth	7	0	Virulent (toxigenic)
12. Str. haem. Group A untyped	Filtrate of 24-hr. broth cult.	1	0	Virulent (invasive)
13. Bact. typhosum Vi strain	,, ,,	5	0	,, ,,
14. Bact. paratyphosum B	,, ,,	4	0	,, ,,
15. Bact. paratyphosum A	,, ,,	1	0	,, ,,
16. Bact. aertrycke	,, ,,	1	0	Virulent
17. Bact. shigae	,, ,,	5	0	Virulent (toxigenic)
18. Bact. flexneri	,, ,,	3	0	Virulent
19. Vibrio cholerae	,, ,,	2	0	,,
20. B. anthracis	,, ,,	2	0	Virulent (invasive)
21. Haem. pertussis	Filtrate of 48-hr. broth cult.	4	0	Virulent
22. Haem. influenzae	,, ,,	4	0	Virulent (invasive)
23. Neiss. gonorrhoeae	,, ,,	1	0	Virulent
24. Ps. pyocyanea	Filtrate of 24-hr. broth cult.	4	0	—
25. B. subtilis	,, ,,	1	0	—
26. Bact. coli	,, ,,	1	0	—
27. Influenza virus	Filtrate of mouse lungs	1	0	Virulent
28. Staph. antivirus	Broth filtrate	1	0	
29. Bacteriophage	Filtrate	4	0	Active against Bact. typhosum; Bact. paratyphosum A, B; B. coli
30. Sat. solution of sulphanilamide	—		0	

For explanation of the significance of 0, +, ++, +++, in recording diffusing activity, and for the meaning attached by us to such terms as virulent, invasive, etc., see text.

* An opportunity may be taken here of correcting three previously undetected errors in that paper. (i) In describing the preparation of the haemoglobin indicator solution the authors intended that the solution of haemoglobin (p. 1467, line 1) should be treated with sufficient sodium chloride to make it isotonic; (ii) the abscissae in Figs. 1 and 2 refer to microgrammes (μg.) of preparation A, not to milligrammes; (iii) on page 1470, below line 12, the " probable limits of error " at the two levels should be reversed (for P=0.95, 83.5 to 120% ; for P=0.99, 79 to 127%) and be described as " fiducial limits."

In this paper we apply the term "invasive" in the sense widely used by bacteriologists to characterize the ability of certain micro-organisms to enter the body through a "porta invasionis," to multiply in the body, and eventually to be deposited in different organs by means of the circulation. McClean and his associates give to the term "invasive" a different and more specific meaning, applying it to the ability of micro-organisms to invade the tissue locally, to multiply there and cause destruction of tissue, as shown in cases of gas gangrene or staphylococcal infection. Under this altered definition, invasiveness and spreading activity are closely related, and production of the spreading factor is one of the properties characterizing the "invasive microbe."

From Table I it appears that there is no relation between diffusing activity and the toxigenicity or invasiveness (as defined by us) of the micro-organisms tested. Some potent toxin producers, such as *Corynebacterium diphtheriae*, showed no diffusing activity, thus confirming a fact to which McClean (1941a) has drawn attention; on the other hand, certain micro-organisms of high invasiveness, such as *B. anthracis, Bact. typhosum, Brucella melitensis*, also showed no diffusing activity. The only species yielding diffusing factor were staphylococcus strains (both albus and aureus), pneumococcus, and streptococcus. The amounts of diffusing factor produced differed in different types and strains, but its presence was correlated with virulence to mice or rabbits.

Any role, therefore, of diffusing factor in promoting virulence of micro-organisms must be limited to a few species only. Among anaerobic toxin producers, diffusing factor has been detected in *Cl. welchii* and *Vibrion septique*, and to some extent in *Cl. oedematiens* (McClean, 1936), but not in others that are highly toxigenic, such as *Cl. tetani*. Diffusing factor is absent from most of the micro-organisms characterized by general invasion of the host. It is possible that there is some connexion between diffusing and necrogenic activities of the micro-organisms tested (to which McClean refers as local invasiveness); the latter is marked in staphylococcus, pneumococcus, streptococcus, and *Cl. welchii*. (The chemotactic effect of some metabolic products of these micro-organisms is known.)

We tested different phages of the *Bact. typhosum–paratyphosum* group for the presence of diffusing factor, with negative results; *Ps. pyocyanea*, showing high fermentative activity during its growth, also gave negative results. Of filtrates from our penicillium strains, one isolated as an occasional contamination on agar plates showed pronounced diffusing activity. Saturated aqueous solutions of sulphanilamide showed no diffusing activity, a fact that may be of importance in the local application of sulphonamides to wounds, as indicating that presence of the drug does not enhance the spread of the micro-organisms or their products. A strain of *Sac. cerevisiae* grown on synthetic medium showed only insignificant growth (after forty-eight hours) and no diffusing activity in the filtrate. The same strain grown on 1% glucose broth showed marked growth and yielded a filtrate that gave maximal diffusion. Here the presence of peptone and glucose enabled the latent property of the yeast to develop, showing that the appearance of diffusing factor in the medium depends on a sufficiently vigorous growth of the micro-organisms.

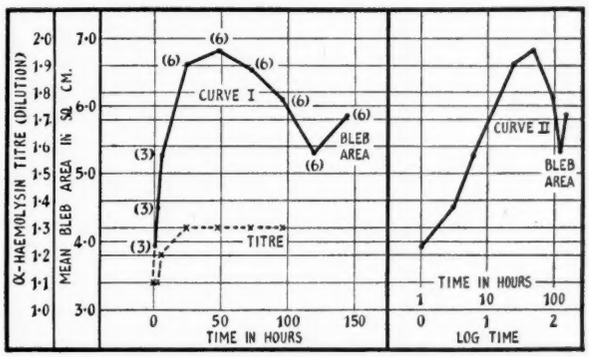
The influence of the medium on formation of diffusing factor by *Staph. aureus* was tested. There was a slight difference, due to the type of medium used, in so far as staphylococcus grown on synthetic medium in CO_2 gave somewhat enhanced figures. Passage through a Seitz filter has decreased the titre of diffusing factor in the filtrates, but passage through a Berkefeld filter caused only insignificant reduction, as McClean (1936) also found both for diffusing factor and for hyaluronidase.

Toxin		Mean Bleb Area (3) in sq. cm.	
A.	Unseitzed	6·43 (++)	No effect
A.	Seitzed	6·60 (++)	
B.	Unseitzed	8·27 (+++)	Significant reduction
B.	Seitzed	6·40 (++)	

A was produced from organisms grown on agar, B from organisms grown on agar-synthetic medium for staphylococcus toxin.

The addition of glucose to the medium had no apparent influence on the amount of diffusing factor in staphylococcus and pneumococcus filtrates. Micro-organisms, such as *Ps. pyocyanea, Bact. shigae*, and streptococcus, which did not produce diffusing factor on the usual medium, failed also to do so when glucose or serum was added.

The production of diffusing factor by *Staph. pyogenes* is shown in the Chart in relation to time and growth of the culture. Curve I shows bleb area plotted against time (in hours), with the number of blebs in parentheses; curve II



Graph showing the production of diffusing factor and α-haemolysin by *Staph. aureus* (227) in plain broth.

shows bleb area plotted against log time (in hours). It will be noticed that there is a close linear relation between the second, third, and fourth points on the second curve and that the departure from linearity of the first and fifth points is what would be expected if the usual sigmoidal relation were expressed by the curve. As it has been shown (Bacharach, Chance, and Middleton, 1940) that within the limits involved bleb area is lineally related to the logarithm of the amount of diffusing factor used, it follows that the amount produced in this culture was lineally related to time of incubation.

Increase of diffusing factor in the medium is rapid after two hours to about twenty-four hours, continues for the next twenty-four hours, and begins to decrease after forty-eight hours; this lowering of diffusing factor titre may be due to the influence of temperature at 37° C. There was no correlation between the increase of diffusing activity and the titre of α-haemolysin. Broth filtrates tested at a time when diffusing factor is markedly increasing did not show the presence of staphylococcus toxin as demonstrated by α-haemolysin or toxin effect on the rabbit; this confirms the independence of the two principles in broth cultures of staphylococcus. The correlation between the actual number of micro-organisms in the medium and the titre of diffusing factor is shown in Table II.

TABLE II

	Number of Micro-organisms	Mean Bleb Area (6) in sq. cm.
Staphylococcus aureus:		
5-hour culture	179×10^6 in 1 ml.	4·05 (0 to +)
24-hour growth	569×10^6 in 1 ml.	5·98 (++)
48-hour growth	569×10^6 in 1 ml.	7·57 (+++)

The number of micro-organisms was estimated by the opacity-tube method. Although allowance has to be made for some inaccuracy in counting by this method, it appears that the amount of diffusing factor increases in the first twenty-four hours concurrently with growth of the micro-organisms and still increases during the stationary period in the next twenty-four hours.

It is reasonable to conclude that, although diffusing factor is produced by micro-organisms during their growth and liberation of diffusing factor is associated with growth, its production is independent of the rate of toxin production.

In the *Staph. aureus* groups we have so far found that only toxigenic strains produce diffusing factor, but that the production of toxin and of diffusing activity are independent seems clear from the Chart. The two properties of the staphylococcus culture are also differently affected by heat and formalin, as shown by the experiments summarized in Table III.

Heating staphylococcal diffusing factor for thirty minutes at 45° C. destroys the activity, while heating at 55° C. destroys it in only ten minutes. At those temperatures staphylococcus toxin is but slightly affected, as shown by the α-haemolysin titre. Formalin at 0.3% concentration and room temperature does not affect the diffusing factor of staphylococcus cultures, but at that concentration slightly accelerates the inactivation of the factor at 37° C. The effect of the two factors, formalin and heat, was examined by McClean (1936) on diffusing factor from *Cl. welchii*, with similar results.

TABLE III

Description	Mean Bleb Area (3) in sq. cm.	Titre of α-haemolysin
(1) Staph. toxin kept in refrigerator	6·60	1/512 C
(2) Staph. toxin + 0·3% formalin kept in refrigerator	6·23	1/128 TR; 1/16 AC
(3) Staph. toxin at room temperature ..	7·30	1/512 C
(4) Staph. toxin + 0·3% formalin at room temperature	6·47	1/64 TR; 1/2 AC
(5) Staph. toxin at 37° C.	4·33	1/2 TR
(6) Staph. toxin + 0·3% formalin at 37° C. ..	3·43	—

C=complete haemolysis. AC=almost complete haemolysis. TR=traces of haemolysis.

There was a rough correlation between the action of formalin on diffusing factor and on the α-haemolysin, as shown in Table III, but inactivation of the α-haemolysin is more pronounced.

Charcoal, which adsorbs staphylococcus toxin, also adsorbs the diffusing factor completely from filtrates of staphylococcus toxin.

Summary and Conclusions

Results of a modified semi-quantitative method for evaluating diffusing activity by the rabbit bleb procedure are described.

Diffusing factor was found among the pathogenic group of aerobic micro-organisms only in staphylococcus, pneumococcus, and streptococcus.

There is no correlation between the general invasiveness or toxigenicity of a wide series of pathogenic micro-organisms and their production of diffusing factor.

Production of diffusing factor is correlated with time of incubation, but is independent of the rate of toxin production.

Formalin at 0.3% concentration does not affect the diffusing activity of staphylococcus cultures. At 37° C. the diffusing activity diminishes; heating the diffusing factor for thirty minutes at 45° C. destroys it.

We wish here to express our gratitude to Prof. A. Miles and to Dr. D. McClean for supplying us with certain strains used in these experiments, and especially to the latter for much helpful comment, criticism, and discussion.

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THE STERILIZATION OF SURGICAL RUBBER GLOVES

BY

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Much has been written from different points of view about the sterilization of surgical gloves. One of us (D. A. S.), finding himself responsible for the sterilization of the gloves at a busy hospital, searched for facts that would ensure sterility while causing the least possible damage to the rubber. The growing shortage of raw material added increased urgency to the problem. After scrutiny of the literature he found that he had gained some knowledge on the destruction of micro-organisms by heat and an acquaintance with many opinions, which were not clearly accompanied by evidence and frequently were conflicting.

Two questions required answering: the first was, "Using a standard autoclave, what are the minimum requirements of pressure and time to enable sterility to be guaranteed?"; the second was, "If more than one technique is satisfactory, which is least detrimental to the rubber?" The value of other methods of attaining sterility, such as boiling or the use of chemical action, also requires investigation, but these methods present problems that are best considered separately.

Bacteriological Technique

While the various chemical colour changes may be valuable in routine sterilization it is essential that for experimental work of this nature the indicator should consist of highly resistant sporing organisms. Cotton-wool swabs liberally soaked in a mixture of soil and water were dried and inserted into the inner recesses of a glove. After the test the swab was plated and incubated aerobically and anaerobically for periods varying from four to eight weeks. In no case did a culture which had remained sterile for seven days become positive at a later date. At first cultures of *Staph. aureus* were also included, but, as anticipated, this coccus proved far less resistant than the soil organisms.

Autoclaving Technique

Packing the Gloves.—Each test was carried out personally according to the following principles. The glove containing the test culture was placed in a cotton packet with another glove; this packet was packed in the centre of a batch of thirty similar packets in a standard drum. The drum was cylindrical, 14 inches in diameter and 5 inches deep, and was provided with apertures at the periphery which could be closed by a sliding band; the lid remained shut during the sterilization. The details were exactly those used in the normal sterilization in the Infirmary, and in fact the test drum was often included with a routine batch.

Working the Autoclave.—The first vacuum is produced (the apparatus used in this work was capable of reducing

the pressure to −18 in. Hg). Steam is then admitted to a pressure of 5 lb. and maintained for one minute. A second vacuum is now produced. Steam is again applied at the pressure in use for sterilization. Drying is satisfactory after fifteen minutes of vacuum and fifteen of airing (an air-heating coil is used). The use of a double vacuum is essential if it is required to reduce deterioration of the gloves to a minimum. This is demonstrated by the following results: (*a*) Sterilization was adequate with a double vacuum if a pressure of 5 lb. was maintained for twenty-five minutes. (*b*) With a single vacuum it was found that at the same pressure forty minutes were required. (*c*) Since deterioration of rubber is proportional to the temperature, it occurs almost entirely during the process of steaming.

Some older types of apparatus are unable to produce a pressure as low as −18 in. Hg, so tests were carried out using a vacuum of ten inches: any instrument in good order should be able to reach this moderate figure. It was found that there was no loss of efficiency provided the double-vacuum method was followed. This is probably to be explained as follows: The first steaming results in condensation of water on the cold material that is to be sterilized; the second vacuum causes the water so formed to evaporate; the steam produced washes the last traces of air out of the drum. Such a process is most effective in eliminating air from the chamber and does not require a high degree of vacuum. That this process is occurring is suggested by the very much longer time taken to achieve the full vacuum after a short steaming than when the chamber contains air only. It can even be observed that this increase of time is roughly proportional to the quantity of material loaded into the sterilizer.

Bacteriological Results Obtained

The double-vacuum technique was employed on all occasions: (1) at a pressure of 20 lb. ten minutes were required for sterilization; (2) at a pressure of 10 lb. twenty minutes; and (3) at a pressure of 5 lb. twenty-five minutes. All results were repeated, and were accepted only if confirmed on three occasions. The combination finally accepted—No. 3 above—was tested and confirmed on ten separate occasions. It is significant that of five tests at 5 lb. for twenty minutes four remained sterile, and one culture became positive only after a period of incubation of five days. This suggests that a pressure of steam of 5 lb. maintained for twenty-five minutes gives a fair margin of safety.

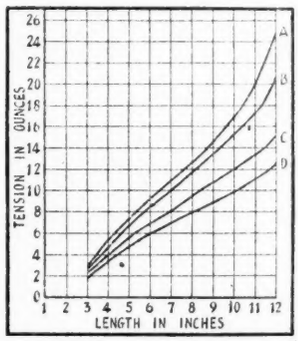
Loss of Elasticity

Having established certain definite combinations of time and pressure that would guarantee sterility, it was now necessary to turn to our second question, "Which of these methods is least detrimental to the rubber?"

Sample strips of the cuff of a new surgical glove were cut to three inches in length and half an inch in width. The elasticity of these strips was measured and recorded; the strips were heated in the sterilizer and their elasticity again estimated. This measurement is made very simply by clamping each end of the strip, fixing one end, and adding a series of weights to a pan suspended from the other end. The length of the strip at different tensions is then recorded. Each test was carried out three times, but variations of over half an ounce on either side of the mean were not observed. The results have therefore been recorded for simplicity in the form of the mean of each group of test strips.

Group 1: Heating for 72 minutes at 20 lb.
„ 2: „ „ 144 „ „ 10 lb.
„ 3: „ „ 180 „ „ 5 lb.

The figure of 72 minutes was chosen arbitrarily to represent the period of heating that would occur with six sterilizations, the generally accepted life of a glove. Any figure of the same order would have been suitable. Having chosen a time for one of the pressures, the remaining times were found from the ratios of the times of effective sterilization at the different pressures under examination. The respective losses of elasticity will therefore represent the efficiency of the different methods. For ease of comparison the results are here presented in graphic form.



These curves represent the results of stretching the test strips under increasing tensions.

A = Before heating.
B = After heating for 180 minutes at 5 lb.
C = „ „ „ 144 „ „ 10 lb.
D = „ „ „ 72 „ „ 20 lb.

These curves demonstrate very clearly that the lower the pressure used the less the destruction of material, in spite of the longer time required.

The cost of fitting a regulator to the ordinary autoclave so that a pressure of 5 lb. may be automatically maintained should be roughly £30. The value of an average load of gloves is about £25.

Conclusion

These results suggest that, with adequate elimination of air from the chamber, steam at atmospheric pressure (0 lb.) might sterilize effectively with even less deterioration in the rubber. The investigations cannot be hurried, as long periods have to be spent waiting for the results of culture; therefore, because of the sense of urgency, already mentioned, it has been decided to publish the work in its present incomplete form. This speculation on the possibilities of cutting the pressure down to atmospheric level leads to an interesting conclusion: the gloves would be subjected to physical conditions similar to those of sterilization by boiling and yet would be dry at the end of the process. It is therefore not too much to hope that the long-standing controversy between the protagonists of "wetness against wastage" and those of "dryness desirable" might finally be settled in the realization of the dreams of both.

In order to determine the glycogen content of the liver in different conditions, D. S. MacIntyre, S. Pedersen, and W. G. Maddock (*Surgery*, 1941, **10**, 716) removed small pieces of liver during abdominal operations on 33 patients. These were divided into four groups. In 10 patients with "normal livers," under spinal anaesthesia, the average value of hepatic glycogen was 3.15%, the lowest figure being 1.1 and the highest 6.3. In 7 similar cases, also operated on under spinal anaesthesia but given glucose in the evening and morning before operation, the average percentage of liver glycogen was 5.03, the values ranging between 3.19 and 7.56. Five patients with normal livers and operated on under nitrous oxide and ether anaesthesia, and given pre-operative glucose, were found to have an average liver content of glycogen of 4.72%. Four patients with what is described as "advanced hepatic pathology" were given 200 grammes of glucose in the twelve hours immediately before operation; the average percentage of hepatic glycogen in them was 2.87.

Medical Memoranda

Objective Tinnitus

The emission of rhythmic sounds from the region of the ear may be muscular or vascular in origin. The condition is well known, though rare. A case of the former type, recently examined, possessed features of such interest—as much to the psychologist and the rhinologist as to the otologist—that it seems worthy of report and comment.

CASE REPORT

A private aged 29 was sent for consultation because his comrades were bothered by clicking noises apparently coming from his right ear (he himself was not greatly concerned about them). These had begun insidiously some eight months previously, before he had entered the Service, were becoming more pronounced, and were said by his wife to be maintained during his sleep. The left ear was also becoming similarly affected, though intermittently and in less degree. He had noticed slight deafness, especially during colds, for the past two years. Since boyhood he had been subject to "catarrh" and "rheumatism." Three years ago he began to get asthma, which affected him mostly at night, and hay-fever, which was confined to the true pollen season. Since then he had undergone tonsillectomy and a series of nasal operations, including submucous resection of the septum, removal of polypi, and "drainage of the frontal sinus." His mother is asthmatic; but his father, two sisters, and one brother are healthy and show no sign of allergy or unstable nervous system.

On examination he was seen to be rather sallow and atonic but of good physique. Ticking sounds, with a crepitant quality, or like the clicking of one finger-nail on another, could be heard at a distance of four feet from the right ear. They were not quite regular, were repeated some eighty-four times a minute, and were thought at first to correspond with the carotid pulse, but this was not so. They could be heard best exactly opposite the auditory meatus, and not so well before the open mouth. The rhythm was momentarily altered by swallowing or chewing, but not by general exercise. I was not able to detect any regular movement of the tympanic membrane, nasopharynx, or muscles of the neck, floor of the mouth, soft palate, or pharynx. Both tympanic membranes were opaque and retracted, but air conduction of sound was greater than bone conduction, and a soft whisper was heard at three feet with the right ear, at four feet with the left. The mucosa of the nose and nasopharynx was more than usually moist and turgid. Otherwise no abnormality was found.

The patient struck me as being of above average intelligence; he was co-operative, but was so unconcerned by his affliction and its effect upon others as to suggest the "belle indifférence" of hysteria. He seemed quietly content that his parlour-trick should interest the several medical people to whom he was shown.

Major A. T. Macbeth Wilson examined him from the psychiatrist's point of view, and reported as follows: "He has a long history of ill health, with nocturnal paroxysmal asthma and an addiction to nasal surgery. In my view, quite apart from his tinnitus, he is suffering from an untreatable hypochondriacal anxiety state, and it would be wise to separate him from military service by early discharge. If this is not done, the reaction of his psychological and aural condition will certainly produce rapid deterioration."

COMMENT

The striking feature of the literature on this subject is that almost all authorities stress the neuropathic nature of the patients concerned. It would seem that the manufacture of the noises is merely a bizarre expression of an underlying neurosis which under different circumstances would have been made manifest in some other way. Kafka (1934) states that "it occurs in neurotic persons." In a discussion at the Royal Society of Medicine (*Proc. roy. Soc. Med.*, Otol. Sect., 1910, **3**, 1) most speakers accented the mental aspect, and one said these patients "usually end in a lunatic asylum." Jewell (1917) reported a case in a girl aged 11 who was neuropathic. In this connexion the previous history in the above case is interesting. Surely his "catarrh," "rheumatism," asthma, hay-fever, "addiction to nasal operations," and objective tinnitus are all attributable to the same basic condition—whether it be called allergy, endocrine dysbalance, vasomotor instability, neuropathic disposition, etc. Bredlau (1938) describes the condition occurring in a boy of 9, and says it affects "only" children. Certainly this seems to be the rule, but one of Tilley's (1910) cases and my own case prove there are exceptions.

It is perhaps natural that most of the reports have come from otologists, and that discussions have gravitated towards the mechanism whereby the sounds are produced. The theories put forward have been many and various, but none is both complete and satisfactory. There seems little doubt that there is a rhythmic contraction of muscle, and among those indicated are: (*a*) "the muscles round the Eustachian tube" (Viole and Love, 1935); (*b*) movements of the soft palate causing separation of the walls of the Eustachian tube with a clicking sound (Politzer, quoted by Bredlau, 1938); (*c*) stapedius or tensor tympani (Kafka, 1934); (*d*) muscles of the floor of the mouth and the soft palate (Tiiley, 1910). I gained the impression that in my case the man was contracting his internal pterygoid and associated muscles in such a way as to obtain crepitus from his temporo-mandibular joint. In a case of Tilley's "it made her jaws ache," and it ceased when the mouth was opened.

Fortunately this matter seems to be of no more than academic interest, and there is certainly no indication for any local treatment. The prognosis depends entirely on the psychological outlook.

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Glasgow Health Report

Glasgow in 1940 had the lowest birth rate on record (19.1 per 1,000 of population) and the highest general death rate recorded for several years (16.8). The high death rate is attributed to the spell of severe weather that prevailed in the early weeks of the year. During one week in January the death rate rose to 41 per 1,000. A higher mortality from infectious diseases was largely due to an increased death rate from diphtheria. There was an unusually low incidence of scarlet fever, an outbreak of measles in the summer, a comparative absence of whooping-cough, and a relatively high incidence of cerebrospinal fever, with 457 cases and 93 deaths. There were more deaths from both pulmonary and non-pulmonary tuberculosis in 1940 than in previous years. Notifications of pulmonary tuberculosis increased by about 20% over the figure for the previous year, the number being 1,905. A careful analysis of the occupation in all notified cases of pulmonary tuberculosis has been made during the last two years, and little increase has been found in the number of military cases or cases occurring among the professional class, the domestic class, and scholars; the real increase has been among labourers, tradesmen, and factory workers, skilled or unskilled. Sir Alexander Macgregor, in his annual report, mentions that measurements of height and weight have been taken in Glasgow schools of between 12,000 and 14,000 boys and girls, and all the measurements were an improvement upon those for 1939, particularly in the case of school entrants. The results, he says, may be taken as implying that school children have lost none of the improved physical condition that has been so marked a feature in recent years. There is no indication of an increase in the incidence of scurvy or rickets. Particular attention has been paid to the supply of vitamin C for infants and young children, and mothers have been instructed about the various substitutes for orange juice. Large supplies of cod-liver oil have been distributed from clinics. The number of child welfare centres in the city is now 15, with 92 weekly sessions. With the annual report for the city is embodied that for the port health authority. During 1940 the number of ships arriving from foreign ports was 1,533, a larger number than during 1939, and 301 cases of infectious or other illness were found on board, the largest increase being in diphtheria and measles.

Reviews

THE HORMONAL SYSTEM

Endocrinology: The Glands and their Functions. By R. G. Hoskins, Ph.D., M.D. (Pp. 388. 18s. net.) London: Kegan Paul, Trench, Trubner and Co., Ltd. 1941.

Of the making of books on endocrinology there appears to be no end, which renders it all the more appropriate that each new one should show a *raison d'être*. There is no difficulty in finding one for Dr. R. G. Hoskins's *Endocrinology*, for not only are the facts presented in an attractive form, but the general considerations are more fully and clearly discussed than in any other recent work we are acquainted with. His arguments may be formulated thus. Protoplasm is a labile mass exposed on all sides, without and within, to forces which threaten its disintegration. Yet out of this composite instability emerges the stable individual by virtue of a complex of protective mechanisms. Of the various controlling mechanisms, the nervous system is pre-eminent, but to a large extent its messages are individual, like a telephone, whereas the hormonal system is like a broadcast to which the body responds as a whole, subject to the receptive capacity of any individual part. Hormones particularly influence those functions which are in the main periodic; corresponding with the rhythms of the body are the hormone tides. As agents to facilitate sluggish reactions, the hormones would fall with the enzymes into the class of catalysts.

The relation between these two great protective mechanisms varies with the different glands. The anatomical connexion between them is at its closest in the pituitary and adrenals. At the other extreme, the corpus luteum appears to be quite independent of nervous influences, though quite responsive to a hormone from the anterior pituitary. Indeed the interactions between the different glands are so intricate that it is doubtful if a uniglandular disorder can actually exist. This carries implications which are not always given due weight. Since each gland may produce a secretion in subnormal, normal, and supranormal amounts, when two hormones enter into the picture the three levels of each can be combined to produce nine permutations. Three hormones give twenty-seven combinations, and so on. Yet the different conditions merge and confront us with a complex of shifting equilibria. Again, quite as important are the variations in the ability of the body, or of individual organs, to react to a given hormone. Little is known as to the factors influencing this tissue reactivity. Some of these are probably the acid–alkaline balance, the temperature of the body or its environment, age and sex, and season of the year. Many interesting problems are discussed in the light of these data, and stress is laid on the therapeutic difficulties which arise from this complicated state of affairs. While discouraging premature optimism, Hoskins is hopeful as to the future, and the whole book is a striking exposition of the advances that have been made towards an increased chemical control over the body.

LIVER FUNCTION IN SURGERY

The Rôle of the Liver in Surgery. By Frederick Fitzherbert Boyce, B.S., M.D. (Pp. 365; illustrated. 27s. 6d.) London: Baillière, Tindall and Cox. 1941.

There are some books which are so novel in their scope and original in their subject-matter that one instinctively feels that they are destined to be recognized as pioneer classics from the moment they are published. Such was Kanavel's monograph on infection of the hand, and such, we believe, *The Rôle of the Liver in Surgery*, by F. F. Boyce of New Orleans, will prove to be. This monograph was awarded the quinquennial Samuel D. Gross prize for research in surgery in 1940, a recognition well merited.

It must be within the experience of the majority of surgeons to have had unexpected deaths after operation upon the biliary passages: unexpected because the patients were judged to be good operative risks, and because the post-mortem findings failed to reveal any convincing cause, or, if any immediate cause was displayed, to show any satisfactory reason why it should have occurred in that particular case. This book is an attempt to solve the problem. The first section deals with "liver deaths" from the "hepato-renal syndrome," that peculiar condition in which, after operative procedures upon the biliary system and occasionally after abdominal trauma, severe burns, or operation elsewhere, death occurs fairly quickly with evidence of severe kidney dysfunction and often with hyperpyrexia. This is a picture which in some ways recalls the "crush syndrome." The author's thesis is that many of these deaths could be avoided by the application of an adequate test for liver function, followed, if necessary, by the institution of special pre-operative measures. The second section deals with "autolytic peritonitis," and here his conclusion is that liver necrosis is the primary cause and that any infection with gas-forming or other micro-organisms, though very important to the outcome, is entirely secondary and catalytic. This conclusion is supported by such a wealth of personal experimental work, and by such a critical examination of the work of others, as to make it appear almost certainly proven.

Seeing that tests for liver function occupy an important position in the preservation and handling of these cases, it is not surprising that considerable space is devoted to an examination of their accuracy as a practical guide. Of many tests investigated the conclusion is reached that Quick's hippuric acid test is the most generally applicable, for it is safe, inexpensive, and simple. With such a simple test it is possible to follow the changes of liver function during the course of any illness with ease, and this the author has done in a large number of cases, not only of biliary diseases, but also of non-hepatic diseases. One interesting outcome of this study was that in toxic thyroid disease the liver is involved, and that hepatic failure may be a common cause of death in thyroid crises. There are many other interesting chapters on various aspects of the subject, including of course one on the haemorrhagic diathesis in jaundice and the relation of vitamin K to this.

Altogether this is a most absorbing book and one which will take a high place in medical literature.

THE MAYOS AND THEIR CLINIC

The Doctors Mayo. By Helen Clapesattle. (Pp. 822. $3.75.) Minneapolis: University of Minnesota Press. 1941.

The title of this book, be it noted, is not "The Mayo Brothers," but *The Doctors Mayo*, for the author is at pains to point out the large part the father played in the success of the sons. Their interest in medicine was hereditary, and they claimed descent from John Mayow, of recently rehabilitated fame. The father was born at Eccles, studied medicine in Manchester, and became assistant to John Dalton. His was a roving disposition; he migrated to the Middle West at a time when its towns often justified the descriptions in *Martin Chuzzlewit*, and its medical standards were to match. An enthusiast in the "horse and buggy" days, he possessed vision but was so unbusinesslike that the sons were brought up in poverty. Incidentally, his dispenser became Sir Henry Wellcome. The "little doctor," as the father was called, became enthralled by Paget's *Lectures on Surgical Pathology*, and the sons, nothing loath, attended his post-mortem examinations when

mere children. They served an informal apprenticeship in all branches of medicine and surgery long before they entered their medical schools, Will going to Michigan and Charles to Chicago at a time when Osler maintained that the American system of medical education was "a byword among the nations." Sewell, the instructor of Will, prophesied he would never succeed, though Will himself maintained that he would return to Rochester and become the greatest surgeon in the world. But the "little doctor's" patients did not appreciate the services of such young men, who spoke of those experiences as their "toe in the door" days, descriptive of their technique in obtaining entrance to the patients' abodes.

The inception of the Mayo Clinic was almost fortuitous. In 1883 a cyclone at Rochester devastated many houses, and the victims were cared for in a dance-hall. Then the Sisters of St. Francis offered to build a permanent hospital if Dr. Mayo would assist. Not wishing to create a monopoly, he asked other doctors to join but was met by evasions and refusals, so great was the terrorism exercised by religious bigotry against a Roman Catholic institution. Here was the opportunity for the newly qualified sons, and they seized it. Will was fully aware that "investment in the appearance of success pays a good return," and he lived up to his own maxim; Charles was more happy-go-lucky in such matters. But both were enthusiasts in surgery, then at an active stage of advance. Will specialized on the abdomen, Charles roved all over the body. Following up Fitz's work on perityphlitic abscess, Will declared in 1888 that the appendix was the origin of such troubles and coined the word "appendicitis." They travelled extensively to see the work in other clinics, and, claiming no originality, maintained that their method was to "gather up good ideas from many men and assemble them as a whole," together with "persistent and systematic reviewing" of their own cases. Will's natural capacity as a speaker helped to spread their ideas; his rule was, "Begin with an arresting sentence; close with a strong summary . . . above all be brief." Charles, on the other hand, had doggedly to teach himself to be a good speaker and in time developed a discursive and humorous style of his own. So the work prospered and increased. Men of distinction such as Graham, Plummer, Kendall, and Cabot joined the staff. The old doctor died in 1911 at the age of ninety-two; though for a good many years he had been hardly a help, his sons, mindful of the past, loyally endured him. In 1914 the clinical research laboratories were opened, but it is not possible to assign a date for the founding of the clinic as distinct from the hospital, so gradual was the process. The Mayo Foundation for medical education and research was incorporated in 1915, and later in the year was affiliated to the University of Minnesota, not without opposition. A medical service was a later but equally successful development. In 1937 there were as many as 210 Foundation Fellowships awarded. "The most amazing thing about the Mayo Clinic," said an English surgeon who held one of these fellowships for several years, "is the fact that five hundred of the most highly individualistic profession in the world could be induced to live and work together in a small town on the edge of nowhere, and like it."

W. J. Mayo ceased to operate in 1928 when he was sixty-nine, and Charles broke down in health eighteen months later. In 1939 they both passed away within two months; united throughout life, in death they were not divided.

A fascinating story of achievement, told by an enthusiastic admirer at considerable length. The illustrations include photographs of the brothers at different ages which show that, while they did much for surgery, their profession greatly developed their own personalities.

Notes on Books

In *Psychiatry for the Curious* (London, Jarrolds, 5s.) Dr. GEORGE H. PRESTON, Commissioner of Mental Hygiene for the State of Maryland, has attempted to present modern psychiatric ideas in language and concepts so simple as to be fully intelligible to the ordinary layman uninstructed in the subject, because he says quite correctly that psychiatry suffers from jargon and implies perhaps less correctly that the whole subject would be perfectly simple if people only talked about it in simple terms. Such a book needs to be reviewed by two quite different people: one to decide whether the author gives a reasonably accurate picture of his subject from the technical point of view, and the other to estimate whether this picture is in fact intelligible to the uninstructed layman. The reviewer can vouch for it that although the treatment of the subject is very superficial—a small book of only 112 pages cannot but be superficial—a reasonably accurate presentation of the trend of modern psychological thought as it is applied to psychiatry is given, while he is told by "an uninstructed layman" that it is reasonably intelligible. However intelligible it may be, any simplification of such a complex and difficult subject is likely to be misleading, and while the book may serve to allay curiosity (which, after all, is all that its title claims) it is doubtful if in itself it is of much value as a means of instruction.

Dr. FRANK TRINCA has made a well-intentioned effort to indicate what he regards as *The Missing Link in Democracy* and the methods by which it could be supplied (Melbourne: J. T. Picken and Sons). His recommendation is the setting up of a consultant panel, representative of all the talents, members of which will alternately follow their own profession or business and act in an advisory capacity in the Government. This he believes would prevent recurring slumps and booms, which in their turn are the breeding ground of war. To the "haves" and "have nots" he neatly adds a third category, the "must haves." We wonder whether the last class would be satisfied with economic stability or whether their appetite would not grow with eating.

The Department of Scientific and Industrial Research has issued No. 2 of Volume 13 (September, 1941) of the *Index to the Literature of Food Investigation*, and it is published by H.M. Stationery Office at 4s. 6d. The entries are, as usual, divided into fifteen sections, and there is an index to the authors whose papers are abstracted.

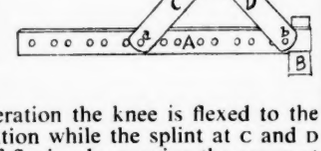
Preparations and Appliances

SPLINT FOR USE AFTER TOREK'S OPERATION FOR UNDESCENDED TESTIS

Dr. M. E. M. BLANDEN writes from the Borough General Hospital, Ipswich:

This easily constructed splint has been found to be useful in maintaining the correct position of the leg after Torek's operation for undescended testicle. The one splint may be used for right or left side.

The main strut A consists of a piece of wood 4 ft. long by 4 in. wide and 1/2 in. thick. This is perforated at 2-in. and 4-in. intervals in its whole length. At one end it is screwed on to the centre of a baseboard, B, 12 in. by 4 in. C and D are of equal lengths, approximately 1½ ft. by 4 in.; perforated at both ends and joined by nut and bolt at *c*. This is then attached to main splint A at *a* and *b* by nuts and bolts.



At the completion of the operation the knee is flexed to the desired degree, and held in position while the splint at C and D is adjusted to an equal degree of flexion by moving the screw at *a* either up or down. The padded splint is now bandaged to the outer side of thigh and leg and kept to the side of the trunk up to the axilla by means of a binder.

As convalescence proceeds the angle of flexion is decreased and the leg gradually lowered. The foot is free to be exercised by the patient, and so the risk of foot-drop is avoided.

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THE PRODUCTION OF ANTIBODIES

For many centuries men have realized that in certain infections one attack gives a long and lasting immunity. The ancient Chinese, for instance, attempted to immunize against small-pox in the first millennium B.C., while Thucydides, in describing the plague which devastated Athens during the Peloponnesian War in 430-425 B.C., expressly noted that those who had once recovered from the disease, whatever its nature, were henceforth quite immune. It is only in recent years, however, that, largely as a result of the use of refined physico-chemical techniques, an accepted body of fact and theory has been gathered in regard to such matters as the factors determining antigenicity and antigenic specificity, the chemical nature of antibodies, and the physical and quantitative aspects of antigen-antibody union: these questions have been fully and critically discussed by Marrack.[1] Far less attention, however, has been paid to the more biological aspects of immunological theory: to the quantitative response to antigenic stimuli and to the way in which this is modified by such factors as age, the physiological state, and the past immunological history of the animal; the qualitative differences in antibodies produced under different conditions; the function of serum globulin in the circulating plasma; the cells responsible for antibody production; and so on. A mass of facts collected in the course of experiments on immunological problems and of practical importance is available, but comparatively few efforts have been made to correlate all these observations and thus to elucidate the general laws of immunology. An attempt to modify this deficiency has recently been made by Burnet, Freeman, Jackson, and Lush[2] in the first of a series of monographs published from the Walter and Eliza Hall Institute, Melbourne.

It is now generally agreed that the formation of immune bodies is one of the aspects of protein synthesis in cells, but in cells that have been modified in reaction in virtue of past experiences. Before discussing the various theories of antibody production in relation to protein synthesis that have been put forward we must recapitulate certain facts on which there is general agreement. Antibody molecules correspond physically to one or other of the types of globulin molecule found in the normal serum of the animal species subjected to the antigenic stimulus. The type of globulin molecule used varies with the species and with the type of antigen: a fact having the important implication that either different components of serum globulin are produced by different cells of the reticulo-endothelial system, or, more probably, that the same cells react differently to different types of stimulus. A second or later contact with the same antigen provokes a more active yield of antibody; more especially with toxoids the latent period is shortened, the antibody titre rises more rapidly and to a higher level, and the rate of subsequent fall is slower. Again, antibody in the circulation is undoubtedly being constantly removed at a rate approximately proportional to its concentration, while its production is a function not only of the cell originally stimulated but of its descendants. Though direct proof is impossible, it is not unreasonable to assume from their lability in numbers that the life of any one cell of the reticulo-endothelial system is short, and that when antibody production goes on, as it does for months or years, other cells than those initially stimulated must be responsible. The usually quoted evidence of the longevity of reticulo-endothelial cells is the persistence of thorium dioxide in the reticulo-endothelial cells of liver and spleen for years after an intravenous injection. If, however, a thorium-containing cell disintegrated, the insoluble foreign material would in the long run be taken up by another cell of the same type. Burnet and his colleagues therefore conclude that the antibody-producing mechanism can be transmitted to descendant cells by some hereditary process—an explanation which, though they do not mention the fact, supposes a somatic mutation, a type of Lamarckian inheritance like that put forward to explain the genesis of malignancy. An alternative explanation would be that a small amount of antigen remains in each reticulo-endothelial cell; when the cell dies and disintegrates the antigen, just like the thorium dioxide, would be taken up by a new cell of the reticulo-endothelial system.

The currently accepted theories of antibody production, which must take into account the various facts already mentioned, are those put forward by Breinl and Haurowitz,[3] Haurowitz,[4] and Mudd,[5] according to which antibody is serum globulin synthesized in direct spatial contact with the antigen molecule, with the result that active patches with a complementary structure to the determinant groups of the antigen are formed on those aspects of the globulin molecules which have been suitably placed in relation to the antigen. As each antibody molecule is produced it is liberated, and the antigen pattern is then available for a further antibody molecule to be synthesized in contact with it. The theory has no real physico-chemical basis, as there is no adequate reason for believing that simple juxtaposition of the growing globulin molecule to the antigen molecule would lead to the development of a complementary pattern. In fact, Best[6] and Stanley[7] use the same arguments as Haurowitz and Mudd to show that protein synthesized in contact with a pattern—in this case tobacco mosaic virus—will form not a complementary pattern but a replica of the original pattern. In particular, the Haurowitz-Mudd theory of antibody production falls to the ground if it is accepted that antibody production can continue after destruction of the antigen molecule. The same argument may also be applied to the more recent theory of Pauling,[8] who, though he makes an improvement by regarding antibody molecules as bivalent rather than multivalent, nevertheless believes that all antibody molecules are synthesized, or at least have their specificity determined, in direct contact with the antigen molecule. In these circumstances Burnet and his colleagues have advanced another theory grounded on the conception by Bergmann and Niemann[9] of the dual proteolytic and protein-synthetic activity of intracellular proteinases. These proteinases may be the living cell proteins which, just like the virus nucleo-proteins, have in virtue of enzyme activity the power to reconstitute themselves in detail from amino-acids or other protein fragments available. The modifica-

[1] "The Chemistry of Antigens and Antibodies." Med. Res. Cncl. Sp. Rep. Ser. No. 230, 1938, London.

[2] *The Production of Antibodies: A Review and a Theoretical Discussion.* Monograph No. 1 from the Walter and Eliza Hall Institute, Melbourne, 1941.

[3] *Z. physiol. Chem.*, 1930, **192**, 45.

[4] *Klin. Wschr.*, 1937, **16**, 257.

[5] *J. Immunol.*, 1932, **23**, 423.

[6] *Austral. chem. Inst. J.*, 1937, **4**, 375.

[7] *Amer. Naturalist*, 1938, **72**, 110.

[8] *J. Amer. chem. Soc.*, 1940, **62**, 2643.

[9] *J. biol. Chem.*, 1937, **118**, 301; *Science*, 1937, **86**, 187.

tion of the proteinase unit which follows contact with the antigen is not to be regarded as resulting from a synthesis of a new unit in spatial contact with the antigen, but rather as a process analogous to the manufacture of adaptive enzymes by bacteria.

It must be noted that any explanation of the phenomena of antibody formation on these lines would be impossible if the primary antigen remained constantly present in contact with the antibody-producing units. The classical example usually quoted in support of the view that antibody formation continues in the absence of antigen is yellow fever, where immune bodies have been demonstrated in the serum fifty years and more after the illness. Now our failure to demonstrate antigen in monkeys that have recovered from yellow fever—the relevant experiments of Hindle[10] are unnoticed by Burnet and his colleagues—may be due to the inadequacy of our technical methods. In other cases—bird malaria, equine infectious anaemia, psittacosis, and lymphogranuloma venereum—we know that the antigen may remain in the body for very many years, the persistence of the antigen being apparently bound up with the continuance of immunity. To this extent, therefore, the theory propounded by Burnet and his colleagues, as they themselves admit, has a weak link; it will, however, stimulate further researches into one of the most fascinating problems of biology.

FORMATION OF KETONE BODIES

Perfusion experiments *in vitro*, particularly by Embden and his colleagues (1906-8), and comparison of the concentration of ketone bodies in the arterial and venous bloods of various organs *in situ*, established the fact that the liver is the principal source of ketone bodies, the other tissues making them only in minute quantities. The *in vitro* perfusion experiments also showed that fatty acids, certain amino-acids, and pyruvic acid were the chief precursors of the ketones, the fatty acids being the most important in this respect. This fact has been confirmed by many animal experiments and clinical observations.

The classic theory of the mechanism of ketone production from fatty acids is that of β-oxidation, postulated by Knoop in 1905. The long-chain fatty acids were supposed to undergo oxidation at the carbon atom in the β-position from the carboxyl group. This resulted in the splitting off of acetic acid ($CH_3.COOH$), leaving a straight-chain fatty acid with two fewer carbon atoms. This process was repeated until a four-membered chain (butyric acid: $CH_3.CH_2.CH_2.COOH$) was left which, though oxidized, did not split up, so that β-hydroxybutyric acid ($CH_3.CHOH.CH_2.COOH$) and β-ketobutyric acid (aceto-acetic acid: $CH_3.CO.CH_2.COOH$) were left as final products. Acetone is generally regarded as a breakdown product of these two other compounds. In this scheme odd-numbered fatty acids could not give rise to ketone bodies. There was much experimental backing for this theory both *in vitro* and *in vivo*, but recent work has led to modifications. The acetic and butyric acids which should be formed could not be detected in the liver, and six years ago Deuel and his colleagues[11] were able to show that feeding the fatty acids with longer chains yielded greater amounts of ketone bodies than did feeding the shorter-chain acids: certainly, feeding equimolar amounts did not produce equal ketone-body formation. These discrepancies, and others concerned with the oxygen consumption of isolated tissue slices, were not apparent if the theory of Hurtley[12] was adopted. By this theory the fatty-acid chain was supposed to undergo simultaneous oxidation at alternate carbon atoms followed by splitting into 4-carbon-atom units. Here there would be no formation of acetic or butyric acid, and if the 4-carbon fractions appeared as aceto-acetic acid it would account for the greater production of ketone bodies after administration of the higher fatty acids, and also for their production from odd-numbered fatty acids. Jowett and Quastel[13] in an extensive series of *in vitro* experiments had shown that ketone bodies were formed by liver slices from valeric acid ($CH_3.CH_2.CH_2.CH_2.COOH$) and from other acids with odd-numbered carbon chains. They also showed that ketone bodies came in greater quantities from hexanoic ($C_5H_{11}COOH$) or octanoic ($C_7H_{15}COOH$) acids than from butyric acid. These facts led them to postulate a multiple alternate oxidation theory similar to that of Hurtley. McKay and his colleagues[14] have lately confirmed these findings *in vivo* and also shown that acetic acid is itself ketogenic. They have therefore proposed a β-oxidation-acetic-acid condensation theory of ketone-body production. The alternate carbon atoms of the fatty acid, according to this view, undergo oxidation and split off to form acetic acid molecules which condense to form the ketone bodies—an equimolar process with even-numbered carbon chains, or leaving propionic acid residues in the case of odd-numbered chains. These residues may be assumed to condense to form sugar, as feeding propionic acid alone causes an increase in liver glycogen with no ketosis. This theory overcomes the difficulty of the splitting into 4-carbon groups which was biochemically difficult to visualize in Hurtley's theory, and also accounts for the greater production of ketone bodies from hexanoic acid than from butyric acid. Soskin and Levine[15] in a recent review look upon the McKay theory as the most satisfactory up to now.

With regard to the regulation of ketosis, it is now recognized that ketosis may occur during the metabolism of considerable amounts of carbohydrate, and it has not been possible to relate the degree of ketosis to the rate of carbohydrate oxidation. This does not support the view of earlier workers that ketone-body excretion was present only in cases of faulty carbohydrate metabolism. There is also ample evidence that both β-hydroxybutyric acid and aceto-acetic acid are metabolized normally in the peripheral tissues, and no failure of this metabolism has been demonstrated in diabetes or starvation. Soskin and Levine therefore conclude that the ketosis is brought about by increased production rather than by faulty metabolism. The fats do not "burn in the fire of the carbohydrates." They explain the ketosis of starvation and of diabetes as due to depletion of liver glycogen with consequent increase in the relative importance of fat as a substrate for oxidation in the liver. The antiketogenic properties of carbohydrates and protein are thus attributed to their glycogenic action, the antiketogenic action of protein being inferior because some of its constituent amino-acids are ketogenic, as is also the ammonia produced by deamination of amino-acids.[16] Another type of antiketogenic agent acts by competing with the ketogenic acids for the enzyme system responsible for breaking them down to ketones[13]; these substances may yield less or no ketones. Odd-numbered fatty acids fall into this category, as do certain amino-acids, benzoic, cinnamic, and α-aminobutyric acid.

10 *Brit. J. exp. Path.*, 1932, **13**, 135.
11 *J. biol. Chem.*, 1935, **109**, 597; 1936, **116**, 621.
12 *Quart. J. Med.*, 1916, **9**, 301.
13 *Biochem. J.*, 1935, **29**, 2143, 2159, 2181.
14 *J. biol. Chem.*: 1940, **135**, 157, 183; **136**, 503.
15 *Arch. intern. Med.*, 1941, **68**, 674.
16 *Biochem. J.*, 1935, **29**, 2082, 2498.

TROPICAL HYGIENE IN INDIA

The importance of improving the health and well-being of labour in tropical countries can scarcely be too much emphasized, whether considered from the financial, economic, or other point of view. Much that is applicable to this problem has been done in recent years in discoveries regarding tropical disease and methods of prevention. But while laboratory and experimental field work can point the direction, it is upon the co-operation of those whose interests are at stake that disease control as a practical and effective measure will depend. A striking lesson in this respect is to be learnt from the report of the Commitee of Control, Ross Institute of Tropical Hygiene (India Branch), for the year ending July 31, 1941. This is a second report following upon that for the previous year, in which are briefly reviewed the research and other activities of the Ross Institute Organization in India during the first ten-year period in which it has been functioning. Malaria control naturally occupies the most important place in the Branch's activities. Under this head is given a brief description of recent cheap and economical methods. These include the so-called "naturalistic" or "biological" methods, such as the use of dense shade in protecting drains and streams by use of quick-growing shade-producing plants, also the now much-developed method of "flushing," in which streams are made automatically self-flushing so that they become unsuitable for mosquito breeding. The results of such work, as shown in improved health of the labour on those gardens where surveys and operations have been carried out under the supervision of the Institute, are briefly set out in tables, as also data regarding the "training centres." These last supply workers trained in anti-malaria methods to tea estates, municipalities, and rural areas in Assam, Bengal, and other parts. In one such centre 16 assistant medical officers, 56 qualified compounders, and 150 non-medical persons were trained during the year. It is not, however, only to antimalaria work that attention is being given. Much has been done also in provision of improved water supplies, installation of suitable conservancy, improvement in housing, maternity and child welfare, and other branches of tropical hygiene. Perhaps the most significant feature of the report is one of the appendices which gives in tabular form those who have subscribed, through the India Tea Association or otherwise, towards these results. Here are listed some 30 Agents and Companies controlling over 200 tea gardens and other estates of an area approaching half a million acres, as well as mining and other industries. The extent of the co-operation achieved augurs well for the future work of the Institute and the benefit of those supporting it. The report is illustrated with some excellent photographs.

SIMPLIFIED SULPHONAMIDE TREATMENT

An interesting suggestion about the method of administering sulphapyridine to casualties in the field is made by Capt. R. Andrew[1] of the Australian Army Medical Corps, whose studies were made mainly on sick and wounded evacuated from Libya. It is often difficult, if not impossible, to administer drugs at four-hour intervals during transit from the front line to a base hospital. In order to decide whether longer intervals between doses are consistent with adequate effect, repeated estimations of the concentration of the drug in the blood were made in men all receiving the same total quantity but in different individual doses. The amount given was in each case 9 g. on the first day, 6 g. on the second, and 4 g. on the third: in three cases the whole was given in one daily dose, in three others divided into two twelve-hourly doses, and in a further three into six four-hourly doses. There was some individual variation in the blood levels attained regardless of the system of dosage, illustrating the well-known fact that the absorption of this drug is erratic and apparently depends on some factor yet to be identified; this variation also excused the author, as he points out, from any duty to adjust the dose accurately according to body weight. The blood level was naturally steadier with more frequent dosage, but the extent of the fall at the end of twenty-four hours when only one dose was given daily was only to about two-thirds of the maximum. Although perhaps a twelve-hour interval is to be preferred when it is feasible, these observations show that even a single large daily dose maintains a concentration in the body which should control infection. Apart from convenience, this simplified system has other advantages. The very large initial dose causes a rapid rise in blood concentration to a high level at the outset, thus securing maximum effect at the earliest stage. The patient has not to be awakened at night, and, although nausea and vomiting occur as frequently as when shorter intervals are used, "the psychological factor in vomiting is not inconsiderable, and the patient is happier if not assaulted at frequent intervals with the drug he blames for his nausea." It was also found that with the lapse of time after a long-interval dose nausea diminished, so that shortly before the next was due there was usually "a reasonable appetite." The author of this paper is to be congratulated on having made some most useful and careful observations in circumstances which are presumably not conducive to leisurely and thoughtful study. It should perhaps be pointed out that these findings are not applicable to treatment with sulphanilamide. Andrew quotes authors who found that in the horse this drug attains a higher average blood level when given only once a day than when the same total dose is given at shorter intervals, but this is entirely at variance with what is known to occur in man. Sulphanilamide, owing to its much greater solubility, is absorbed more quickly and more regularly than sulphapyridine, and hence is excreted sooner; a single daily dose would entail a fall to an ineffective blood level before the next was due, and even two-daily dosage is not to be recommended. The fact that infrequent doses of sulphapyridine secure a persistently adequate blood concentration may come to be regarded as its main advantage over sulphanilamide for use under field conditions.

[1] *Med. J. Australia*, Nov. 29, 1941.

REHABILITATION OF THE TUBERCULOUS

The success of such a scheme as that of the Ministry of Labour for the training and resettlement of disabled persons must depend upon a wide interpretation of the term "disabled person," and we therefore welcome the announcement from the Ministry of Health that some discharged tuberculous patients are to be regarded as coming within the scope of the scheme. The object of the scheme, which was discussed in its relation to others already in operation in the *Journal* of December 6 (p. 813), is to re-employ in the most skilled work of which they are capable persons who suffer injury, not only on war service and in air raids, but through accidents in factories and elsewhere. The procedure is that an official of the Ministry of Labour discusses the question of future employment with the patient before he leaves hospital; he also sees the patient's doctor; and on the basis of these discussions arranges a suitable training course for the patient after discharge from hospital. By

this means it is hoped to secure that before a disabled person is sent to a training centre or to new employment due regard is paid to his own preference, to the degree and nature of his disablement, and to the opportunities and demand in particular trades. It is this scheme, with its provision for training within travelling distance of the patient's own home at Government centres, technical colleges, and employers' works, which the Ministry of Health (Circular 2576) now proposes to extend to those who have been under treatment for tuberculosis, but who are capable of undertaking whole-time employment under ordinary conditions. The circular states that recommendations for training should be made on behalf of those only in whom the disease is quiescent, and likely to remain so, or in whom, in the case of pulmonary tuberculosis, the sputum is negative. Tuberculosis officers are asked to send particulars of such patients to the nearest employment exchange, when the procedure followed will be the same as for any other disabled person, except that the patient will probably be interviewed in his home. The continuance of medical care is, of course, essential to the success of these arrangements, and local authorities are therefore asked to see that any patients dealt with under the scheme receive medical supervision or treatment through the dispensary services. The Ministry of Labour will provide medical attention at its own training centres either by the direct appointment of a medical officer to the centre or by co-operation between the centre and a near-by E.M.S. hospital. The Tuberculosis Association, at a recent meeting called to discuss this application of the Ministry's scheme to tuberculous persons, passed the following resolution, which has been submitted to the Ministry:

"That the Tuberculosis Association enthusiastically welcomes the Ministry of Labour's decision to include tuberculous persons in its scheme for the training and resettlement of disabled persons, and urges that the Ministry should proceed to put this into effect without delay. The association in this matter recognizes the need for the observance of two fundamental principles in the application of this scheme to the tuberculous: (1) That the suitable case for training and resettlement and the type of employment for which the patient is best fitted should be decided jointly by the tuberculosis officer and the representative of the Ministry of Labour, with the help of the medical superintendent of the institution in which the patient last received treatment. (2) That the principle of part-time employment with subsidized wages is essential for the success of the scheme. The association wishes to add that a special subcommittee has been formed to explore the ground in greater detail, and that further views of the association, in the light of the recommendations of the subcommittee, will gladly be placed at the disposal of the Ministry of Labour. The association also wishes to draw to the attention of the Ministry of Labour the memoranda on this subject that have been prepared in the past by the Joint Tuberculosis Council, the latest of which is about to be published."

BLOOD GROUPS AND RACIAL ORIGINS

Since it was discovered that the proportions of the blood groups varied in different populations many observations have accumulated on the subject. In fact, it would probably be true to say that more is known about the geographical distribution of these genes than about any others, whether plant or animal. In a useful summary Haldane[1] brings together data for Europe, totalling about half a million persons. One striking feature is the rise in B and the fall in O from west to east, the percentage of persons of Group B rising from about 8 in Western Europe to 20 or more in European Russia. Variations in the relative numbers of O and A are characteristic of the Atlantic fringe, particularly of the British Isles. Figures recently provided by Taylor, Race, and Fisher,[2] and based on large numbers, show the following percentages of O and A: Southern England, O=45, A=43; Northern England, O=48, A=40; Scotland, O=52, A=34. Ireland is lower still in A, and Iceland lowest of all. All these variations are of great anthropological interest, for the information provided is of an unequivocal character not matched by any other measurement. In the first place the blood groups are entirely determined by heredity, environmental influences being of no effect; secondly, the mode of inheritance is simple and well understood; thirdly, to belong to a particular blood group can confer, at most, only a very slight selective advantage or disadvantage, for nothing of the kind has yet been demonstrated. In contrast to this, pigmentation is undoubtedly adaptive, and a population could change appreciably during a relatively short period of time. Cranial indices depend on measurements which are certainly affected to a considerable extent by non-genetic influences. Thus, whereas these latter measurements may reveal the recent history of a population, its blood-group characters must depend on remote origins. Haldane shows that present blood-group frequencies cannot be explained by mutation rates of any order which it is reasonable to postulate. It is likely that the present blood-group frequencies are to be referred to a time when man was a rare animal living in small and relatively isolated communities. Chance association between particular genes and favoured and multiplying stocks would come to yield wide variations. This is indeed found to-day among North American Indian tribes, some of which are largely O in composition, while others are very high in A. The frequencies found in modern populations are to be attributed to subsequent multiplication, and to the migration and crossing of peoples. Haldane agrees with the view that the great majority of B genes in Europe are due to Asiatic infiltration.

There can be no doubt that blood-group investigations will come to possess an importance in anthropology second to no others. To quote one or two examples: the round-headed Alpine salient separating the long-headed Nordics and Mediterraneans has been attributed to migration from the East; but Haldane points out that there is no counterpart in blood-group frequencies, Vienna being no more eastern than Berlin. Fisher and Taylor[3] have pointed out the great difference between Scotland and Scandinavia in the frequency of A, and conclude that the Scandinavians who settled in Scotland (and Iceland) were very different from the Scandinavians of to-day. The possibility of investigating the effect of recent migration is illustrated by an observation of Fisher and Vaughan,[4] who found that persons with Welsh surnames living at Slough were significantly lower in A than the remainder of that population. At the present time very large numbers of blood donors are being enrolled in connexion with the various blood transfusion services, and it may be confidently anticipated that a study of the figures will yield important, and it may be unexpected, anthropological results. There could be no more promising field than these serologically variable islands.

Among the new Fellows of the Royal Society elected on March 19 are J. H. Burn, M.D., professor of pharmacology at Oxford; F. M. Burnet, M.D., assistant director, Hall Institute for Medical Research, Melbourne; Malcolm Dixon, Sc.D., lecturer in biochemistry at Cambridge; E. C. Dodds, M.D., professor of biochemistry, Middlesex Hospital; N. Hamilton Fairley, M.D., lecturer at the London School of Hygiene and Tropical Medicine and now in Australia as Colonel A.A.M.C.; and Edward Hindle, Sc.D., regius professor of zoology at Glasgow.

1 *Human Biology*, 1940, **12**, 457.
2 *British Medical Journal*, 1941, **2**, 315 (report of meeting).
3 *Nature*, 1940, **145**, 590.
4 Ibid., 1939, **144**, 1047.

GALLANTRY IN CIVIL DEFENCE

In a second *Supplement* to the *London Gazette* dated February 27 the award of the M.B.E. (Civil Division) to Dr. JOHN ANDREW MACLEOD, medical practitioner, Alnwick, Northumberland, is announced. The announcement reads as follows: "During an air-raid a child was pinned between two floors of a wrecked house which was liable to collapse. Dr. MacLeod climbed into the house by an upper window and, although the floor on which the boy was trapped was hanging from the beams, he managed to administer a morphine injection. The child was then released and passed to the doctor, who removed him to safety. Dr. MacLeod showed courage without regard for his own safety."

In a *Supplement* to the *London Gazette* dated March 13 the award of the G.M. to Dr. HALSTEAD MIDDLETON TURNBULL, medical officer, Works First-aid Post, Birmingham, is announced. The announcement reads as follows: "Dr. Turnbull has been on duty during every air raid on Birmingham. He has shown cool courage and resolution, without regard for his own safety, and, by his skill and resourcefulness, many lives have been saved and much suffering alleviated. When the building in which the first-aid post is situated was damaged by bombs, the doctor, despite the difficulties, searched for and treated persons buried under debris. On numerous occasions he has been called to treat casualties trapped in wrecked buildings. In order to administer morphine to an injured woman, he lowered himself head downwards into a narrow space regardless of the danger from a wall liable to collapse. When an area was evacuated owing to the presence of a time-bomb, Dr. Turnbull stayed with a woman who was seriously ill until such time as she could be moved with safety."

Correspondence

War Neurosis

SIR,—I was very interested to read Major J. A. Hadfield's constructive article on war neurosis (Feb. 28, p. 281, and March 7, p. 320), and with many of his views I find myself in close agreement. The statistical approach, from which so much new knowledge can be gained, is to be warmly welcomed. Since the beginning of the war we have had over 3,000 neurotic soldiers pass through this hospital, and at the present time the summary cards of the first 2,000 are being statistically analysed. It is instructive to note that, despite the differences of approach, our figures show considerable resemblances to those of the 41st General Hospital. But it is to be remarked that, as Major Hadfield admits, the diagnoses in his Army hospital had to be distorted to allow of certain methods of disposal, and therefore do not give quite a true picture of the clinical material, which is probably very much the same as with us. In our 2,000 cases I note: head injury, 109; other organic states, 51; epilepsy, 70; schizophrenia, 50; manic-depressive syndromes, 51; mental deficiency (not necessarily certifiable), 137; making 23% in this group as compared with Major Hadfield's 8.6%. Major Hadfield does not mention head injury in his paper. We have found it to be of importance. The 5% of cases noted above included only those men in whom there was definite cerebral injury complicated by neurotic symptoms; there were considerably more in whom the onset of neurosis dated from a concussional episode, which had aetiological significance.

This brings us to the importance of physical factors, which Major Hadfield is inclined to minimize. He makes no mention of such an important thing as loss of weight up to two stone, although it is rare to find a really good personality breaking down under severe stress where there had not been preliminary physical exhaustion. Major Hadfield says very little about physical methods of treatment, and more about the analytic approach. One trusts that in his training course the emphasis was the other way round, as the latter method is open only to specialists, whereas physical methods can be used by any well-trained physician. The 41st General Hospital has not, of course, had the advantage of treating the hyperacute cases of neurosis that followed immediately on Dunkirk; those of us who have had this experience are aware of the indispensability of physical methods in such cases, which are going to be the important ones when the fighting starts again.

Throughout his paper Major Hadfield makes a distinction between constitutional aetiological factors and psychological predisposition. In our experience the effects of these can never be completely disentangled. He says nothing about the frequency of a family history of psychopathy and neurosis; this was present in first-degree relatives in 55.7% of our cases—and that is a minimum estimate. On the basis of what I believe to be a falsely conceived distinction, he remarks: "The figures probably overemphasize the constitutional predisposition, since our investigation included not only the psychoneuroses, which by definition are primarily psychogenic and not constitutional, but cases of psychopathic personality which by definition are of a constitutional nature." Some degree of abnormality or weakness of personality plays a part in practically all cases of neurosis. Psychiatry has come to a sorry pass if problems of aetiology are to be solved "by definition."

Major Hadfield says that 50.6% of his cases were predominantly psychologically caused, and that "we can give only palliative treatment for the constitutionally predispositioned, but can radically cure the psychoneurotic and acquired type since it is in the nature of a conditioned reflex." I would disagree with both the first and the second part of this statement; but if there were 50% of curable cases, how is it that only 15% were cured, only 20% returned to duty, and that 40% of those relapsed in three months? We have treated our cases by a variety of methods: 19% by intensive psychotherapy, 8% by modified insulin treatment, 3% by continuous sleep, and a further 12% by specially directed sedation; the remainder received superficial psychotherapy, occupational therapy, etc. We have returned 20% of men directly to duty, and of the 332 of them whom we have been able to follow up for periods of three months to a year, only 38, or 11%, had later been boarded out. I am far from suggesting that these figures are very satisfactory. I do not believe that we are anywhere near solving the problems of the treatment of neurosis. But for twenty years we have in this country been concentrating on psychotherapy as the only rational method of treatment, and apparently, when put to the test, this is all we can do. Have we perhaps been "barking up the wrong tree"?—I am, etc.,

ELIOT SLATER.

How Much Vitamin D?

SIR,—Many of your readers must have welcomed your annotation (Jan. 10) drawing attention to the small allowance of vitamin D officially provided for infants by the Government in their "cod-liver oil compound." The Ministry of Health, I understand, claims that their dosage agrees with the recommendations of the Technical Commission of the League of Nations. This Commission recommended a daily allowance of 400 to 500 I.U. (League of Nations, *Bulletin of the Health Organisation*, 7, June, 1938, p. 476). So far as I know, no official statement has been made in the medical press regarding the vitamin D content of this "cod-liver oil compound," and many doctors will have had no opportunity of seeing the description on the bottle, where it is stated that 1 gramme contains not less than 100 I.U. of vitamin D, and that half a teaspoonful daily is the maximum allowance for babies under 6 months old. If by half a teaspoonful is meant half a drachm, then the dose provides 175 I.U. of vitamin D daily—that is, about 2/5ths of the allowance advised by the League of Nations Commission. Including the small amount of vitamin D present in milk, a child under 6 months would therefore still be getting less than half the allowance advised by the Commission.

The amount of vitamin D supplement required by infants depends much more on rate of growth (taken as a percentage increase of body weight) than on total body weight; hence the well-known fact that premature babies are extremely susceptible to rickets and require far more vitamin D than full-term babies of the same age. For the same reason, babies under 6 months of age are more susceptible to rickets than older babies. Park has stated that in the United States the maximum incidence of rickets is at 4 months old, which is probably also true for this country. Yet the Ministry allows only half as much vitamin D daily in the first half-year of life, during which the average baby should increase his weight by about 115%, as it allows in the second half-year, when the percentage weight increase should be about 40%.

With the large number of variables operating, such as degree of exposure to ultra-violet light, balance of the diet, rate of growth, etc., it is obviously impossible to state the minimum number of units of vitamin D which must be added to the diet to protect all infants from rickets. I should like, however, in justice to myself to take this opportunity of correcting a misunderstanding. Dr. Cécile Asher (March 7, p. 336) states that I am of opinion that a supplement of "300 units daily may be enough if the baby is kept under observation and the dose doubled at once if early signs of rickets are noted." But if such a construction can be put on my words, I fear I must have expressed myself badly, since if signs of rickets are found prophylaxis has failed. Though my routine dosage of vitamin D is unusually low—i.e., about 300 I.U. daily in cod-liver oil for babies under regular supervision—I frequently increase it. For example, I advise double this dose for full-term babies growing especially rapidly or not getting out of doors daily, also for babies on high carbohydrate diets or for those with dark skins. For most premature babies I quadruple the dose, giving about 1,200 I.U. daily, though of course if cod-liver oil is used care is needed while increasing to this quantity, and an emulsion is better tolerated than the plain oil. The Ministry of Health dosage is, I consider, dangerously low. If there is not enough cod-liver oil to go round, then the babies requiring the largest doses are those under 6 months.

There is another point to which I should like to draw attention—namely, the unfortunate fact that certain non-municipal child welfare centres are not allowed to distribute the free issues of cod-liver oil and fruit juice. Thus mothers bringing children to welfare centres at a maternity hospital are compelled to add to their already heavy housekeeping labours an additional journey to a borough welfare centre or other depot if they wish to collect these supplements. Does the Ministry wish to reduce attendance at voluntary hospital clinics?—I am, etc.,

London. H. M. M. MACKAY.

Standard of Chest Radiography

SIR,—The excellent memorandum by the National Association for the Prevention of Tuberculosis published in the *Journal* of Feb. 28 (p. 302) under the title of "Symptomless Early Tuberculosis: Radiographic Methods for Discovery" is timely. I wish to offer only one critical observation: it is that the memorandum conveys the impression that little more is required to conduct a wider survey for early pulmonary tuberculosis than additional *x*-ray apparatus, after appropriate education of the general public. No concern is expressed as to the very necessary improvement that is required in chest radiography as it is now practised: for wider surveys to be performed efficiently a general raising of the technical standard of chest radiography is demanded.

It will surely be generally agreed that only chest radiographs of good quality are adequate for the study of early tuberculous lesions and to permit reasonable interpretation of discovered lesions by those experienced in chest radiology. Unfortunately the general standard of chest radiography is much lower than it ought to be. In the last few years it has been my privilege to see many hundreds of chest radiographs taken in various clinics, hospital *x*-ray departments, and tuberculosis dispensaries in and around London, which have been assembled for independent interpretation as part of a tuberculosis survey. Many of these radiographs were excellent, but an appreciable proportion were of such a quality as to be quite unsuitable for the discovery of early lesions or, indeed, for the controlled follow-up studies of known lesions.

My impression is that, *with certain exceptions*, the lowest standard of chest radiography is done in clinics in which the sole work is chest radiography. Again, my impression is that often the best work is done in departments in which chest radiography is only a part of the total work. Much of the apparatus in special clinics is ill chosen for the bulk of the work it has to perform, and this even applies to some quite recent installations. In such clinics there is an evident lack of inspiration to achieve *and maintain* a high technical standard. This is probably because those in charge have little opportunity for critical comparison of their routine radiographic work with that of other *x*-ray departments. I would advocate the appointment of consulting radiologists by the various authorities responsible for tuberculosis services to advise on the choice of suitable apparatus, to give direction towards the improvement of radiographic quality, and to aid in the interpretation of chest radiographs when asked by tuberculosis officers.

All that has been said of simple chest radiography applies even more forcibly to miniature radiography (photography of the fluorescent screen image), which is being increasingly used in mass surveys. Everything in this method depends upon a superb technical standard; given this high standard there is little doubt that miniature radiography will act as an efficient sieve to separate out healthy and unhealthy chests.

The N.A.P.T. should strive for an improvement in existing radiographic services *pari passu* with increasing these services quantitatively. No wise architect would add floors to a hospital building when the foundations were unsound. To sum up: in its drive for wider radiographic chest surveys among adolescents and young adults the N.A.P.T. should use its influence in securing a general improvement in the standard of chest radiography as now practised in many existing institutions, and to see that a better standard is carried forward in the chest and tuberculosis clinics of the future.—I am, etc.,

E. ROHAN WILLIAMS, M.D., F.R.C.P., D.M.R.E.
Radiological Department, St. Mary's Hospital, W.2.

The Teaching of Anatomy

SIR,—I have been much interested in the various views recently expressed on the teaching of anatomy and desire to add a few comments. During the preclinical years of the medical curriculum students of anatomy fail to appreciate its application, and much more interest would be aroused in the subject if its study were not entirely confined to this period. At one time hospital attendance and anatomical dissection ran concurrently, and a departure from this has been in some ways a disadvantage. Bearing this in mind, I have arranged for patients to be presented to senior anatomy students, and have been much impressed by the stimulus this gave and the numerous questions raised for discussion. For example, when studying neurology they have at the same time an opportunity of seeing cases with neurological lesions, such as facial paralysis, poliomyelitis, hemiplegia, etc. Much closer co-operation between anatomical and clinical study would be beneficial, and anatomists might be attached to the staffs of teaching hospitals in order to make this possible.

The presentation of the subject has been much changed in the past twenty-five years. The introduction of the living model and radiological study of normal structures in anatomical departments have helped to impress on the student that a knowledge of the anatomy of the living is our aim, and that the dissection of the cadaver is merely a means to an end.

There are those who object to the time spent in dissecting the *whole* body, but I do not agree with this criticism, as my experience in examining has been that those who have merely studied a dissected part invariably showed inadequate knowledge. All our students in the same year of medicine are engaged in dissecting the same part of the body at the same time. Correlated with this are topographical demonstrations and radiological study, an arrangement which has proved an undoubted benefit to staff and students. A course of embryology is necessary for medical students, and much can be done to enhance its value by the demonstration of those deformities and malformations met with in general practice. This can be effected by spending less time on the description of detailed development of organs, much of which is not essential. Many may justly complain that they have been required to amass a number of facts of no apparent value in general practice, and there is good ground for such criticism. One of the reasons for this is that the dissecting-room manuals in common use contain too many topographical details for the requirements of the majority of students, and the beginner readily gets the impression that he has to memorize a large number of *relations* of the structure under consideration, and to remember with precision various *attachments*. Much detail of this kind might reasonably be omitted. For example, as many muscles show individual variations in their origins and insertions, less might be expected from students in this connexion without in any way detracting from their knowledge of the position and action of muscles in the living subject.

In a revised curriculum I would suggest that in the preclinical years there should be instruction in general anatomical principles, including the use of the living model and the radiology of the normal. There should be courses on embryology and post-natal growth, including the factors which modify it. The whole body should be dissected but less topographical detail should be expected from the student. During the later years of the curriculum special courses in anatomy should be arranged in association with the work of final-year subjects.—I am, etc.,

University College, Dundee. D. RUTHERFORD DOW.

SIR,—The letter from the late Sir Henry Brackenbury (March 14, p. 368), appearing as it does within a few days of his lamented death, makes one think of the words of John of Gaunt:

". . . the tongues of dying men enforce attention like deep harmony; when words are scarce, they are seldom spent in vain; For they breathe truth which breathe their words in pain." (*King Richard II*, Act 2, Sc. 1.)

I trust, therefore, that those in authority will well weigh the cogent plea which Sir Henry and other of your correspondents put forward for reducing the large amount of time that medical students are at present compelled to devote to the study of anatomical minutiae "unlikely to be of any practical value to the general practitioner." Sir Henry makes it clear, of course, that he is not referring to the student working for the higher surgical diplomas.

Personally I regard the regulation which compels every medical student to dissect the whole of the body as being comparable, say, with the regulation that formerly made Greek and Latin compulsory subjects for admission to the universities. The opposition to reform, then as now, was due partly to sheer conservatism and partly to the prejudices of those engaged in teaching the subjects in question—a case of the cobbler's "nothing like leather."

It is the unnecessary amount of time devoted to non-essential but old-established subjects in the medical curriculum which makes it so difficult to find sufficient time for those more modern subjects that are really of practical value to the general practitioner.—I am, etc.,

Leicester. C. KILLICK MILLARD.

Amoebic Liver Abscess

SIR,—There is a distinct possibility that in the years to come we may see in this country an increased number of cases of liver abscess as a consequence of the return home of men who have served in areas where amoebic infection is rife. It is therefore incumbent on us all to be on the lookout for such cases, as diagnosis, in the earlier stages at least, may be missed if the possibility is not kept in mind. It should also be known that it is the confirmed opinion of all who have had much experience of liver abscess cases that the essential treatment, and usually the only treatment required, is simple aspiration, repeated if necessary, associated with subcutaneous injections of emetine before and after aspiration. It cannot be too strongly emphasized that the day of open operation is past. In a fairly large series of cases I can remember only one which had to be submitted to open operation, and which was found to be due to organisms other than the *Amoeba histolytica*.

These remarks are prompted by the letter of Dr. C. Cameron (March 7), in which a case treated by open operation is described. "He was discharged from the sanatorium six months after the operation, a big, sturdy, healthy man." I venture to suggest that he might have been discharged in the same satisfactory state in six weeks had the aspiration and emetine treatment been employed. The rapidity and completeness with which large abscesses are cured by this method have to be seen to be believed. There are few things so remarkable or so satisfactory to patient and doctor alike in the whole gamut of therapeutics.—I am, etc.,

Edinburgh. DOUGLAS S. ROBERTSON, M.D.

"Night-blindness"

SIR,—In the *Journal* of Oct. 25 and Nov. 1 an article by Wittkower, Rodger, Scott, and Semeonoff on "'Night-blindness'—A Psychological Study," aroused my interest. All their data and examinations concerned Army personnel, and I wondered whether any of your readers had experiences and observations with regard to flying personnel.

It may be quite coincidental, but my observations on a number of pilots may prove of some interest. Some time ago I had 18 pilots examined for dark adaptability with Livingston's apparatus, and only two of them failed to obtain an above-average result. It had also been my practice to administer vitamin A tablets in the form of capsules, and these pilots had been taking them regularly for at least three months. The two pilots who had failed to obtain the necessary pass mark in their dark adaptability test were both of a reserved, secretive, and uncommunicative temperament. I had noticed how at times these two pilots were quite morose, and although I could not diagnose either airman to be suffering from any psychological disturbance, it occurred to me that they would be the type who would be susceptible to flying stress. My intuitions were partly fulfilled when one of these pilots eventually succumbed to a mild form of flying stress, as diagnosed by a psychiatrist. It then appeared to me that the possibility did exist of there being some close analogy between the pilot's poor night vision and his resistance to psychological stress in flying.

I should be greatly interested to know of any similar observations on this subject.—I am, etc.,

D. LEON,
F/Lieut., R.A.F.V.R.

Spinal Anaesthesia

SIR,—Since 1910, when spinal anaesthesia was first used, over 30,000 spinal anaesthetics have been given at the General Hospital, Nottingham. We have run the gamut of many methods, including hyperbaric stovaine, tropacocaine hydrochloride, decicaine, duracaine, and hypobaric percaine. We have arrived gradually at the conclusion that for general purposes hypobaric duracaine for cases of medium length and hypobaric percaine where high abdominal anaesthesia over a long period is required are eminently satisfactory. From the description of the technique of those who insist on the use of hyperbaric solutions, we are quite confident that the method adopted in this hospital for hypobaric solutions is simpler and safer than some of the methods advocated in recent letters to the *Journal*, and so far see no reason whatever to change our anaesthetic technique.

With reference to Dr. W. M. Maidlow's letter (March 7, p. 339), in our last series of 150 partial gastrectomies satisfactorily carried out and followed up under hypobaric percaine spinal combined with splanchnic anaesthesia (Braun's method), we have neither experienced the danger of the patient slipping off the table nor of a tug-of-war between orderlies and patient. We do not, however, think it wise to be unduly dogmatic even after a lengthy series of cases, and may we heartily endorse Dr. Loftus Dale's plea for flexibility of technique, as each anaesthetist of experience will no doubt find for himself and continue in the use of the anaesthetic and its method of administration which he finds most suited to patient and surgeon.—I am, etc.,

Nottingham. K. S. CRAWFORD.

Preserving the Race

SIR,—I wonder if the intelligent people and the great people and even the bulk of our profession realize the paramount importance at the present moment of the recruitment of our race. Dr. W. G. Willoughby does well to remind us that the countries of the world will eventually be occupied by those nations whose women are content to bear children, however interesting and valuable their other work may be. Japan—Australia! One needn't say more. We can save our Dominions only, if at all, by a change of public opinion towards parenthood. Young married couples expect to be free to enjoy themselves; women earn their share of the household expenses in order to maintain a "higher" standard of living; day nurseries, school meals, family allowances, and tax reliefs may be expedient, but they cannot provide the leisure commonly expected in the life of to-day. The real remedy is psychological.

We must first convince the future parents that children are more attractive and interesting even than dogs; that family life is more satisfying than public entertainment; that the fireside, with simple hospitality and one's own resources, is richer by far than the lavish display and paid goods of the market-place. These rather highbrow considerations, however, must be incorporated into the wider conception of public duty ingrained in every child. From the first they must look forward to healthy marriage and the required minimum of four children as part of

their vocation and the natural completion of their lives. Here is the difficulty, for it is on parents, teachers, preachers, doctors, and statesmen that we have to rely for such teaching, and all too many in these categories are and expect to remain childless themselves. The matter is vital to our national life; it lies at the root of the system of marriage and of sexual morality instituted originally in the interest of the tribe or race and so inculcated by the priesthood, until it is now regarded as lightly as religion itself. But it is only by the overpowering forces of religion and patriotism with a conversion of public taste to simpler forms and intrinsic thought and feeling that the post-war world, as we can conceive it, can possibly be preserved. Surely our profession can be moved to play a quiet but convincing part in this most difficult and obstinate patriotic task.—I am, etc.,

Hatfield. FRANCIS FREMANTLE.

Food Handlers and Food-poisoning

SIR,—May I bring forward a point that may have been overlooked in public health at the present time? Many laboratories dealing with preventive medicine have probably had more than the usual number of specimens of foodstuffs and faeces lately: this with reference to small outbreaks or isolated cases of gastro-enteritis. At the best of times, in the smaller restaurants particularly, there is a deplorable lack of sanitary and cleansing facilities for those handling food. Although complying with regulations these places are usually not kept to the standard of public conveniences. Now we have a large number of newly established canteens. The point I wish to make is that to-day many are handling food who have not previously had much experience, and therefore the bacterial flora in many of these establishments has probably changed, and there are more carriers of salmonella, paratyphoid B, and atypical dysenteries, to say nothing of streptococci from droplet infections or staphylococci from finger lesions.

It seems hard to add to the already harassed public health authorities' work, but perhaps medical officers of health could ask sanitary inspectors to drop a word of warning to staff managers, and ask their co-operation in tightening up in such matters. Extra w.c.s and lavatories cannot perhaps be installed under the difficult conditions of to-day, but the staff could gradually be taught things they are totally unaware of at present. Some rules on these lines could be advanced: (1) All w.c.s, wash-basins, towels, etc., to be kept scrupulously clean: at least as clean as any other place in the restaurant. (2) No person to return to work after defaecation or urination without a careful wash with soap. (3) If a member of the staff is away ill even for a day a little gentle inquiry as to symptoms to be made by the staff manager, and if the case is one of "vomiting" or "diarrhoea" he might keep a record for possible future reference. (4) In the case of prolonged illness of an apparently gastro-intestinal infection the staff manager to notify the sanitary inspector with a view to getting the advice of the medical officer of health. (5) Members of the staff with a "boil" or "place on the finger" to be taken off actual food-handling if possible and put on other duties.

Many will have an elaboration of these rules, but one is diffident about making things too difficult at the present time.—I am, etc.,

London, W.C.1. E. GOODWIN RAWLINSON, M.D., D.P.H.

Medical Man-power

SIR,—It seems obvious from the Ministry of Labour comment on the most recent Royal Proclamation (that which renders men up to the age of 45 liable for National Service) that there is still a great need for medical men in the Forces, despite the Shakespeare Committee's finding that there is no shortage of medical personnel in the country. There must be, then, some failure in the method of allocation. May I be permitted to suggest a form of redistribution which might help to some extent.

It seems to me that there are far too many young specialists—I write as one—still in civilian jobs either in E.M.S. or other hospitals. Many of us in these positions formed the impression in the first year of the war that the possession of a higher degree was something of a stumbling-block to entering the Forces, and it might seem that it still is; but one wonders if a more serious obstruction does not stand in the way of those of us who are now in the E.M.S., and whether employment in that Service may not further prejudice our chances of being called up. Some of us joined the E.M.S. at a time when it seemed likely that it would be called on even more than it had been previously to fulfil its original task. In this we were to some extent correct, but now that there has been a lull in heavy air raids for some time and our duties consist largely of dealing with the waiting-list cases of voluntary hospitals, and now that the demands of the Forces for medical men are so pressing as to necessitate men up to the age of 45 being conscribed, general practice having already done more than its share in meeting demands so far, is it not time that reorganization was undertaken to ensure that we younger men in the E.M.S. and in other hospitals will be called up forthwith?—I am, etc.,

RONALD G. HENDERSON.

The Services

CASUALTIES IN THE MEDICAL SERVICES

Capt. PETER NORMAN WITNEY was killed in Hong Kong in Dec., 1941. He was born on March 31, 1913, the younger son of Dr. and Mrs. E. W. Whitney of Whitstable, and was educated at Cambridge and St. Thomas's Hospital, qualifying M.R.C.S., L.R.C.P. in 1937. After holding posts as clinical assistant at St. Thomas's and house-physician at Torbay Hospital, Torquay, he settled in practice at Tankerton, Kent. He entered the R.A.M.C. as temp. lieut. soon after the outbreak of war and was later promoted capt.

Missing.—Capt. K. P. Brown, R.A.M.C.; Surg. Lieut. C. J. Milligan, R.N.V.R.; Maj. J. M. Officer, R.A.M.C.; Surg. Lieut. J. C. Wyatt, R.N.

DEATHS IN THE SERVICES

Lieut.-Colonel A. P. G. LORIMER, I.M.S. (ret.), died on January 20 at the age of 61. Born in Edinburgh the son of a distinguished Scottish lawyer, he was educated at the Edinburgh Academy, where he made his mark as an athlete. He passed on to Edinburgh University, from which he graduated M.B., Ch.B. in 1905, entered the I.M.S., and after a few years of regimental duty was appointed R.M.O. of the Madras General Hospital. There he carried through an immense work of reform and reorganization. August, 1914, found him and his wife sailing on their first home leave. At Ismailia he received orders to return to India for war service. The result was that he served altogether thirteen years, mostly with the Gurkhas, before returning to this country. In 1920 he achieved home leave, and characteristically devoted part of it to taking the D.P.H. In 1924, his next leave, he took the F.R.C.S.Ed. After serving at Calicut as district civil surgeon he was appointed to Tanjore Hospital and Medical School. This proved to be the most important task to which he had set his hand. His three great qualities were first-rate surgical skill, a remarkable gift for teaching, and a passion for far-sighted organization. To these should be added his remarkable sympathy for the Indian of every race and rank, which instantly commanded loyal co-operation and devotion among his subordinates. His power to inspire his Indian students was unfailing: the most commonplace and self-interested found themselves swept along in the fire of his enthusiasm for all that was noblest in the medical profession. His flaming scorn of the second-rate in aim or in work, and his tenderness and sympathy with the inarticulate Indian patient, whom he protected from every form of exploitation, created a profound impression upon the men whom he trained and whom he fired with much of his own idealism. In the five years that he was in charge at Tanjore he built up a hospital and medical school and organized to a high point of efficiency the medical work of the whole district. But ill-health prevented him from seeing his work perfected and established as he would have wished. In 1934 he was invalided out of the Service with cardiovascular trouble. He spent the remaining years of his life at Harrow, but died as he chose to die in the city of his birth, for above and through all he was a loyal son of Scotland. Lorimer was a man of remarkable gifts and unusual charm. His numerous interests were served by wide reading, a retentive memory, and a great sense of the dramatic. He was a fascinating companion and a brilliant conversationalist.

By a printer's error the surname of Captain John Stobo Prichard, R.A.M.C., to whom the M.C. has been awarded, was misspelt in our issue of March 7 (p. 344).

Obituary

CHARLES HOWARD USHER, F.R.C.S.Ed.

We regret to announce the death of Mr. Charles Howard Usher, consulting ophthalmic surgeon to the Aberdeen Royal Infirmary, and an eye specialist well known south as well as north of the Border.

He was born of a well-known Edinburgh family in 1865, and graduated B.A. at Cambridge in 1886. He qualified in medicine M.B., B.Ch. in 1891, after clinical study at Edinburgh and St. Thomas's in London, and in 1894 he took the F.R.C.S.Ed. After holding house appointments in London, including those of ophthalmic house-surgeon at St. Thomas's and clinical assistant at Moorfields, he returned to Scotland and practised as an ophthalmic surgeon in Aberdeen, where his outstanding abilities and aptitude for original work quickly gained him recognition. On the staff of the Royal Infirmary, Aberdeen, and of the Royal Aberdeen Hospital for Sick Children he served as ophthalmic surgeon for many years. Apart from his clinical practice he interested himself in research on the course of the optic fibres, a subject on which he contributed papers to the Ophthalmological Society of the United Kingdom in the early years of the present century. He was a prominent member of that society and its president in 1927-9, at which time he was also awarded its Nettleship prize for investigations into hereditary diseases of the eye, and for the same work he received the honorary fellowship of the Royal Society of Medicine, the Ophthalmological Section of which he often attended. He was Bowman lecturer to the Ophthalmological Society in 1935. His lecture on that occasion was on a few hereditary eye affections, including an unusual pedigree of retinitis pigmentosa occurring in a family some of whose members had been known to him for forty years. The lecture with its appendices and exhaustive bibliography occupies 80 pages of the official *Transactions*.

Mr. Usher joined the B.M.A. in 1896 and continued his membership to the end of his life. At the Aberdeen Meeting in 1914 he was president of the Section of Ophthalmology. One of his chief recreations was travel, and in his travels he took occasion to familiarize himself with the schools of ophthalmology and the principal workers in this field in different countries. He had also a great knowledge of natural history and was a most entertaining host and companion.

WILLIAM GREENWOOD SUTCLIFFE, F.R.C.S.

Mr. W. G. Sutcliffe, a former president of the Kent Branch of the British Medical Association, and a well-known surgeon in the Isle of Thanet, died recently at Canterbury.

He was born in London in 1867, the son of a doctor, and received his medical training at St. Thomas's, where he was awarded the Cheselden medal in surgery. Qualifying in 1892, he remained for a time as house-surgeon at his hospital, and then for two years was senior house-surgeon at the Hull Royal Infirmary. In 1896 he went out to the Matabele War in what is now Rhodesia, serving under the auspices of the British Red Cross Society. Returning to England, and having taken the F.R.C.S., he settled at Margate in partnership with Mr. W. Knight Treves. He at once joined the staff of the former cottage hospital and later of the new Margate and District General Hospital—an active and devoted association lasting forty-three years. He was for three years president of the cottage hospital, and in 1935 was elected to the same office in the district hospital. Among other appointments which Mr. Sutcliffe held at Margate were those of surgeon to the Royal Sea-bathing Hospital, 1901-6; surgeon for many years to the Princess Mary's Hospital for Children; and medical officer to the Royal School for Deaf and Dumb Children. He was also at the time of his death consulting surgeon to the Thanet Infirmary, Herne Bay Cottage Hospital, and other local institutions. During the war of 1914-18 he served in France in command of a casualty clearing station, had the rank of lieut.-colonel, and was twice mentioned in dispatches and awarded the O.B.E. For over forty years he was president of the Margate Ambulance Corps, which he brought to a high state of efficiency. He was also for more than forty years a member of the British Medical Association, and was elected president of the Kent Branch in 1921. Last November the borough of Margate presented him with its honorary freedom. The family medical tradition is carried on by one of his sons, Capt. W. Greenwood Sutcliffe, R.A.M.C.

SIR HENRY BRACKENBURY

Dr. PETER MACDONALD writes:

To us of the older generation the announcement of the death of Sir Henry Brackenbury was a tremendous blow. I have known him now for many years, first as chairman of the Insurance Acts Committee, later as chairman of the Representative Body, and finally as chairman of Council of the British Medical Association. More recently he took a position of first-class importance in the Voluntary Hospitals Commission, where, owing to the absence of Lord Sankey, he practically acted as chairman. His work on that Commission was of first-rate importance, and its effect upon the development, and indeed on the continuance, of the voluntary hospital is and will be paramount. His powers grew with the years and with the responsibilities attached to the posts he held. He went from strength to strength. His grasp of ideas was the quickest I have known, and his ability to voice these ideas in convincing and simple language was that of the master. He was the greatest man in the councils of the B.M.A. since the days of Horsley, with the possible exception of Bolam, who in a different way was equally great. Their qualities were, however, different, and when they were both in our councils these qualities were complementary. During the last few years he withdrew largely from our councils on account of his increasing deafness, and the loss to us was great: it was the loss of the wise counsellor. Now he has passed away in an enviable manner. No long illness—apparently, indeed, no illness—and, except for his deafness, his powers were unabated. His example will remain an inspiration to those of us who knew him.

Dr. JAMES PEARSON BROWN died on February 21 at a nursing home in Glasgow. He was born in 1868 at Campbeltown, and from George Watson's College, Edinburgh, went to Glasgow University, where he took the M.A. degree in 1889 and then studied medicine, graduating M.B., C.M. in 1893. He was for many years medical officer for the parish of Campbeltown and visiting physician to the local hospital. During the Boer War he served as a civil surgeon in the South African Field Force, and in the last war he held the rank of major, R.A.M.C. (T.A.), and was awarded the D.S.O. and the Territorial Decoration. Dr. Brown joined the British Medical Association in 1902, was chairman of the Argyll Division 1922-7, and president of the Glasgow and West of Scotland Branch 1926-7. He was elected a Fellow of the Royal Faculty of Physicians and Surgeons of Glasgow in 1925, and was a J.P. for the county of Argyll.

Dr. CHARLES FREDERICK WILLIAMSON died on March 8 after 55 years of devoted service at Horley, Surrey. The son of James Williamson, M.D., he was born in London in July, 1865, and went to school at Epsom College, leaving in 1882 with an entrance scholarship to St. Bartholomew's Hospital. He took the M.R.C.S., L.R.C.P., and L.S.A. diplomas in 1886, and a year later went to Horley and served on the medical staff of the Charlwood Cottage Hospital until 1894. Dr. Williamson held a number of local appointments, and had been medical officer to the Horley and District Cottage Hospital since 1914. He joined the B.M.A. fifty years ago. His son, J. C. F. L. Williamson, M.D., F.R.C.S., is in surgical practice at Hove.

The following well-known medical men have died abroad: Dr. ADALBERT CZERNY, for many years professor of paediatrics in Berlin, aged 78; Dr. L. C. BAILLEUL, chief surgeon to the American Hospital in Paris; Dr. RUDOLF SCHOENHEIMER, assistant professor of biochemistry, Columbia University, and formerly director of the department of pathological chemistry in Freiburg, aged 43; Dr. WILLIAM CHISHOLM, for many years senior surgeon at the Sydney Hospital, aged 89; Dr. GUSTAV WOLFF, formerly professor of psychiatry and director of the psychiatric clinic of Basle University, aged 76; and Dr. HANS LÖHR, professor of internal medicine and director of the University of Kiel, aged 50.

Medical Notes in Parliament

Tuberculous British Prisoners in Germany

On March 16 Brigadier-General CLIFTON BROWN asked the Under-Secretary for War whether he was aware that certain of our prisoners suffering from tuberculosis in German camps had been promised to be removed to Switzerland for expert treatment; that this arrangement had now been cancelled; and whether he would again press, through the Red Cross or otherwise, for the transfer of such prisoners to Switzerland. Mr. SANDYS said he was not aware of the promise referred to. All British prisoners of war in Germany suffering from tuberculosis (with the exception of two, whose cases were the subject of a recent protest) had been sent to a special hospital in the Saxon Alps, of which he had received favourable reports.

Sir WILLIAM DAVISON said he had seen a copy of a letter from the War Office to the parents of a soldier who had been promised that he should go to Switzerland, saying that he could not go because the War Office had ceased to press the Germans to send him there. Why had the policy of the War Office been changed in this matter? Mr. SANDYS replied that he could explain this, but he did not think it should be discussed in open session.

Mr. BELLENGER asked if the same principle could not be adopted as in the last war, when these unfortunate people were sent to Switzerland for their benefit. Mr. SANDYS: All who are suffering from tuberculosis in a serious form are eligible for repatriation.

Medical Certificates for Fire Watchers

On March 17 Mr. KIRBY asked the Home Secretary what powers had been given to hardship committees to reject applications for exemption from fire-watching duties where doctors had certified that the applicants were unfit for such duty, and if he would take steps to ensure that applicants for exemption, supported by such medical testimony, should be examined by a doctor representing the Ministry before their applications were rejected. Miss WILKINSON said that the tribunals, which had full powers to require an applicant to submit to a special medical examination, were independent bodies whose decisions were not subject to review by any Government Department.

Mr. CAMPBELL STEPHEN: Does not the Minister consider that the powers of the tribunal should be limited in order that medical certificates should not be set aside unless by other certificates? Miss WILKINSON said that a good deal of revision was going on regarding details, but alteration of the law as it stood was not a matter for the Home Office.

New Treatment for Wounds

On March 17 Mr. KIRBY asked the Under-Secretary of State for War if he could give any information about the new treatment for wounds discovered by a doctor of the Hebrew University of Jerusalem; and whether it was to be adopted generally throughout military hospitals in the treatment of wounds. Mr. SANDYS: This work has not yet passed the experimental stage, and there can, therefore, be no question at present of adopting its results generally. Steps have, however, been taken to give the doctor referred to assistance in his experiments.

Nursing and Midwifery in the Colonies

Mr. HAROLD MACMILLAN told Dr. Morgan on March 18 that examinations for midwives were conducted by Government medical officers in all the West Indian Colonies, and diplomas or certificates of competency were issued by the Colonial Governments. Midwives, or nurses known to be qualified as midwives, were employed by the Governments of Jamaica, Trinidad, Leeward Islands, Grenada, Dominica, and St. Vincent. On the same date Mr. Macmillan gave a general assurance that active steps were being taken regarding the training of European women for work in Colonial medical and health services, as well as Colonial-born students of any race or colour, as nurses, midwives, and health visitors. These schemes were not complete, and a full statement on future Colonial nursing policy must await completion of this preliminary work. Asked whether suitably qualified West Africans were encouraged and permitted to secure medical posts in their own country, Mr. Macmillan said continuous efforts were being made to ensure to West Africans careers commensurate with their talents, training, and qualifications.

Shortage of Nurses

Mr. ERNEST BROWN, on March 19, told Mr. Sorensen that returns from hospital authorities in England and Wales indicated that the number of additional nurses they would be ready to employ if they were available was 13,600. The average ratio of nurses employed to all beds was 24 per 100 beds. The average number of nurses employed to all patients was 40 nurses per 100 patients. He was in communication with the Secretary of State for War about the number of nurses who might be available for transfer from military hospitals to understaffed civilian hospitals.

Tuberculosis among Gold Coast Miners

Mr. MACMILLAN stated on March 19 that two medical officers of the Gold Coast Medical Service had undertaken an investigation into the incidence of tuberculosis and silicosis among mine workers in the Tarkwa area of the Gold Coast between April, 1940, and January, 1941. Their interim report revealed considerable progress. Arrangements were subsequently made for one of them, who was a specialist in these diseases, to visit South Africa to obtain the advice of the authorities in Johannesburg who had special knowledge and experience of these problems. Before adequate preventive measures could be introduced it was necessary to obtain fuller information regarding the dust counts of the atmosphere at the various working places. Arrangements had been made for officers of the Mines Department to receive instruction in this subject. The report showed that the incidence of pulmonary tuberculosis was higher than that of silicosis. The medical officer referred to had now been freed from all routine duties to allow him to devote his full time to the investigation of the incidence of tuberculosis. All known cases of these diseases were receiving the necessary treatment, but the elimination of silicosis must depend on methods of prevention.

Vitamin B, in Canadian Flour.—Fortification of Canadian flour with vitamin B_1 before export to the United Kingdom is not carried out by the Canadian Government but by individual millers. Consignments are sampled on arrival in the United Kingdom and the vitamin B_1 content is determined.

Notes in Brief

Mr. Sandys said that at least 80% of recruits to the Army needed dental treatment on enlistment. Full provision had been made for this by the expansion of the Army Dental Corps and the provision of extra Army dental centres and laboratories and mobile dental units.

Mr. R. S. Hudson is sending a letter to every milk farmer in England and Wales calling on him to do his utmost to keep up the milk supply. The United States is sending over a veterinary expert to assist in dealing with contagious abortion in cattle.

Universities and Colleges

UNIVERSITY OF SHEFFIELD

At a meeting on March 13 the University Council decided that all students entering the University must undergo a medical examination, arranged by the University, as early as possible during their first term. In the case of medical and dental students, whose duties expose them to health risks not encountered by others, further physical examinations are required before and during that part of their course which is spent in hospitals. By this decision the Council has taken an important step towards safeguarding the health of a part of the community. There is no intention of imposing a standard of physical fitness on students, but in cases where disability or a tendency to ill-health is found advice will be given for the benefit of the student. The records of all medical examinations will be confidential and will not be divulged without the student's consent. The scheme is one which, it is hoped, will play its part in directing attention to the real aim of medicine, which is the promotion and maintenance of good health.

EPIDEMIOLOGICAL NOTES

Some European Vital Statistics

Despite the great difficulties that must have been imposed on it by the present world conditions the League of Nations Health Organization has issued its annual report on notifiable diseases for 1938. The report contains the statistics of notifiable diseases for the various countries and the great towns of the world, and also includes data on mortality and births. The death rates by cause of death are given for two years preceding 1938, generally 1936 and 1937. A standardized death rate and rates in quinquennial age groups are given for all causes of death in triennial periods around the recent census years, and for the most recent year for which the data were available. The death rate, birth rate, and infant mortality are given by country for each year from 1925 to 1940, although the values for the last two years of the period are provisional. These rates are also given for the great towns by months during 1938, and annual rates for this year and the immediately preceding years are also shown.

There still appears to be a considerable difference between the various countries in the degree of accuracy of diagnosing the cause of death and in attributing deaths to various causes. This prevents any comparison being made between different countries for specific causes of death—for example, in France the death rate per 100,000 for causes of death not specified or ill defined was 314 and for senility 193; the rates for these causes in England and Wales were 3 and 41 respectively. The degree of accuracy in notifying cases of infectious diseases probably shows very much greater differences between one country and another than the causes of mortality. Although international comparisons are invalidated, the data are sufficiently accurate to show the seasonal fluctuations and the trend of the incidence within any country.

The provisional death rate for 1940 is tabulated for 16 European countries: for 13 countries the mortality was at a higher level than in 1939; one country had the same rate in both years; and in two countries, Austria and Sweden, the rate declined by 0.3 and 0.1 per 1,000. The death rates in 1940 ranged from 10.4 per 1,000 in Denmark to 19.2 in Rumania. The preliminary values of the birth rates for 1940 showed that a decline occurred in about half the countries when compared with 1939. The infant mortality increased during 1940 in half the countries, and varied from 39 per 1,000 live births in the Netherlands and Sweden to 189 in Rumania.

As it seems a matter of topical interest to compare the vital statistics of our enemies with our own experience, the following values were extracted, but they should be treated with great reserve:

Country	General Death Rate			Infant Mortality			Birth Rate		
	1938	1939	1940	1938	1939	1940	1938	1939	1940
England and Wales ..	11·6	12·1	14·3	52	50	55	15·1	14·9	14·6
Scotland	12·6	12·9	14·9	70	69	78	17·7	17·4	17·1
Germany	11·6	12·3	12·7	60	60	63	19·6	20·3	20·0
Italy	14·0	13·4	13·5	106	96	104	23·7	23·5	23·1

Typhus fever has been the subject of much discussion and speculation in recent months. This disease was endemic in a great part of Europe in peacetime. These centres of infection may be illustrated by the number of cases reported during the three years 1936-8. The largest returns were Bulgaria 458, Greece 208, Lithuania 473, Poland 10,791, Rumania 14,317, Czechoslovakia 564, Turkey 1,518, Yugoslavia 2,403. No returns have been made by the U.S.S.R. since April, 1937; the number of cases of typhus reported in European Russia during 1936 was 45,703.

Discussion of Table

In *England and Wales* during the week under review there was a general rise in the incidence of infectious diseases; the only exceptions were whooping-cough and dysentery, which declined slightly.

The number of cases of measles was 215 higher than the total for the preceding week. The biggest rise was in Middlesex—177 to 267 (Harrow U.D. 118, Twickenham M.B. 64). The only other areas with large increases were London and Surrey, with 35 and 29 cases respectively in excess of the total of the previous week.

The notifications of scarlet fever increased from 1,124 to 1,231, and of pneumonia from 1,148 to 1,276. The increases were widespread and there were no big variations in the totals of individual counties.

There were 17 more cases of diphtheria than in the preceding week, and 25 fewer cases of whooping-cough. In contrast to the general trend, whooping-cough in London increased to 164 from 129 cases in the preceding week.

There were 218 notifications of cerebrospinal fever, an increase of 54, or 23%, on the previous week's total. The additional cases were distributed throughout the country and no special increase in incidence was recorded for any county; only five counties in England failed to return a case.

In *Scotland* the figure for measles had risen from 196 to 200, but wide variations in incidence occurred within the country. Edinburgh reported 94 cases, a fall of 41; Glasgow, with 96 notifications, had an increase of 51. The higher notifications of pneumonia were due to a large rise in Glasgow.

In *Eire* notifications of measles rose from 85 to 138. The principal centres of infection were Co. Westmeath, Athlone U.D. 42 cases, and Dublin C.B. 36 cases.

Returns for the Week Ending March 14

The notifications of infectious diseases in England and Wales during the week included scarlet fever 1,260, whooping-cough 1,324, diphtheria 842, measles 2,706, pneumonia 1,403, cerebrospinal fever 230, dysentery 131, paratyphoid 6, typhoid 16. In the great towns 81 deaths from influenza were recorded.

No. 9

INFECTIOUS DISEASES AND VITAL STATISTICS

We print below a summary of Infectious Diseases and Vital Statistics in the British Isles during the week ended March 7.

Figures of Principal Notifiable Diseases for the week and those for the corresponding week last year, for: (a) England and Wales (London included). (b) London (administrative county). (c) Scotland. (d) Eire. (e) Northern Ireland.

Figures of Births and Deaths, and of Deaths recorded under each infectious disease, are for: (a) The 126 great towns in England and Wales (including London). (b) London (administrative county). (c) The 16 principal towns in Scotland. (d) The 13 principal towns in Eire. (e) The 10 principal towns in Northern Ireland.

A dash — denotes no cases; a blank space denotes disease not notifiable or no return available.

Disease	1942					1941 (Corresponding Week)				
	(a)	(b)	(c)	(d)	(e)	(a)	(b)	(c)	(d)	(e)
Cerebrospinal fever ..	218	12	41	8	8	370	29	66	3	14
Deaths		1	3				1	6		
Diphtheria	876	32	183	60	22	1,015	50	298	24	39
Deaths	19	—	6	4	—	23	1	8	—	2
Dysentery	120	20	26	1	—	156	12	23	—	—
Deaths		1	—	—	—		—	—	—	—
Encephalitis lethargica, acute	8	—	—	1	—	6	—	3	—	—
Deaths		—	—				1	—		
Enteric (typhoid and paratyphoid) fever						17	1	1	2	—
Deaths						1	—	—	—	—
Erysipelas			51	9	1			65	5	6
Deaths		—	—				—	—		
Infective enteritis or diarrhoea under 2 years										
Deaths	38	4	8	11	1	33	6	10	3	1
Measles	2,550	213	200	138	47	15,424	287	171	—	6
Deaths	1	1	1	2	—	20	1	1	1	—
Ophthalmia neonatorum	79	4	16		—	70	3	16		—
Deaths										
Paratyphoid fever ..	12	1	2	—						
Deaths	—	—	2	—						
Pneumonia, influenzal*	1,276	62	19	4	14	1,495	70	56	17	5
Deaths (from influenza)	62	10	6	1	—	199	13	15	6	10
Pneumonia, primary ..		62	328	22			—	571	16	19
Deaths				17	15				13	
Polio-encephalitis, acute	2	—				—	—			
Deaths		—					—			
Poliomyelitis, acute ..	3	—	1	1	—	3	—	1	1	—
Deaths		—	—				—	—		
Puerperal fever ..	1	1	7	2	—	—	—	9	2	—
Deaths		—					—			
Puerperal pyrexia ..	197	16	10		—	139	5	7		6
Deaths										
Relapsing fever ..	—	—			—	—	—			—
Deaths										
Scarlet fever	1,231	34	166	46	17	1,161	52	166	29	40
Deaths	—	—	—	1	—	4	—	—	—	—
Small-pox	—	—	—		—	—	—	—		—
Deaths	—	—	—	—	—	—	—	—	—	—
Typhoid fever	10	1	—	9	—					
Deaths	—	—	—	—	—					
Typhus fever	—	—	—	—	—	—	—	—	2	—
Deaths			—	—	—			—	—	—
Whooping-cough ..	1,290	164	45	24	6	3,617	45	822	—	17
Deaths	8	2	—	—	3	41	1	19	—	1
Deaths (0–1 year) ..	430	52	79	43	20	455	33	147	38	24
Infant mortality rate (per 1,000 live births)										
Deaths (excluding stillbirths)	6,049	883	768	294	167	6,439	837	937	272	221
Annual death rate (per 1,000 persons living)			17·3	19·6	†			20·4	18·1	19·4
Live births	5,196	529	760	312	214	5,304	378	916	386	234
Annual rate per 1,000 persons living ..			15·7	20·8	†			18·5	25·6	20·5
Stillbirths	234	37	42			223	10	35		
Rate per 1,000 total births (including stillborn)			52					37		

* Includes primary form for England and Wales, London (administrative county), and Northern Ireland.

† Owing to evacuation schemes and other movements of population, birth and death rates for Northern Ireland are no longer available.

Medical News

Dr. E. D. Adrian, F.R.S., professor of physiology at Cambridge, has arrived in Buenos Aires to give a series of lectures under the auspices of the British Council.

Surgeon Rear-Admiral G. Gordon-Taylor will deliver a lecture on "Abdominal Injuries" at the Weston Hotel, Bath, on Thursday, April 2, at 5.30 p.m. All Service medical officers and civilian practitioners will be welcome.

At a meeting of the Society of Public Analysts and Other Analytical Chemists on April 1, at 5 p.m. in the Chemical Society's Rooms, Burlington House, Piccadilly, W., papers will be presented and discussed on the biological estimation of vitamin P activity, on a new absorptiometric method for the estimation of blood sugar, and on a modified Hilger vitameter "A." Guests may be introduced by members.

The spring meeting of the British Orthopaedic Association will be held in Liverpool on May 29 and 30 under the presidency of Mr. G. R. Girdlestone. The programme will include a discussion on "Delayed Union of Fractures in the Lower Limb," and another on "Methods of Amputation in the Lower Limb—a Comparison of Canadian and British Experience." There will also be a visit to the R.A.F. Rehabilitation Centre at Hoylake. No award of the Robert Jones Medal and Association Prize has been made for 1941.

A priority allowance of two pints of milk a day may now be ordered in cases of "pleurisy, with or without effusion, in which there are reasonable grounds in the opinion of the tuberculosis officer for suspecting that the condition is tuberculous in nature, and in which the priority medical certificate is signed by the tuberculosis officer." The Ministry of Food, in announcing this, also clears up some doubt about the phrase "cases of active tuberculosis," which, it states, should be taken to mean "cases of unhealed tuberculosis." Patients who have had gastric or duodenal ulcers, undergone operations on the stomach, duodenum, or small intestine, or who are subject to chronic dyspepsia may continue to be ordered extra milk and eggs although they are symptom-free; there may be a recrudescence of the disability if these patients are given an unsuitable diet. It is also announced that patients suffering from typhoid fever or amoebic or bacillary dysentery who are being nursed at home may now receive extra eggs on production of the necessary medical certificate.

The January issue of the *Post-Graduate Medical Journal* (the official organ of the Fellowship of Medicine) is devoted to Anglo-Soviet medicine, with a foreword by the Russian Ambassador and an introduction by Sir Alfred Webb-Johnson, P.R.C.S.

Alderman J. G. Graves, a former Lord Mayor of Sheffield, has made a gift through the Graves Charitable Trust of £100,000 to provide Sheffield with a radium centre.

Letters, Notes, and Answers

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QUERIES AND ANSWERS

Treatment of Acute Gonorrhoea

Dr. G. FOSTER SMITH (Dewsbury, Yorks) writes: I should be very much obliged and greatly helped in following up treatment if medical officers who are treating acute gonorrhoea in the Services would tell me exactly what is their treatment of acute gonorrhoea to-day. I wish to know: (1) Is the patient confined entirely to bed, and if so how long? (2) What doses of sulphapyridine are given and over what period? (3) Is irrigation (*a*) used in every case, (*b*) used only in selected cases, or (*c*) not used at all?

"Keens"?

Mr. P. MAYNARD HEATH, F.R.C.S., writes: I have lately come across the term "keens" applied to winter cracks on fingers and thumbs. Is this word in common use and can anyone explain its origin?

"Burning" Hands with Engorged Veins

Dr. S. E. HARVEY (Bexley, Kent) writes in reply to "M.D." (February 21, p. 280): It would be well worth while to try a course of oestrone: (1) 1,000 units twice weekly by injection; (2) 1,000 units orally each day. The injections could be increased in strength up to 50,000.

Treatment for Chilblains

Dr. R. S. HOLZER (Birmingham) writes: In reply to C. C. B. (February 21, p. 280), a successful treatment for chilblains proved to be the protection of the affected areas with elastoplast, which not only prevents new influence of low temperature and friction or pressure, but keeps the local body temperature up. The renewal of the plasters each morning will soon find the patient's approval, as this procedure shows a marked improvement after five to seven days and the troublesome symptoms disappear quickly. The large strips of elastoplast should be applied directly to the skin, and should not overlap.

S. E. H. writes in reply to C. C. B.: This remedy only clears the actual chilblains, but is very efficacious during that time. Instruct the patient thoroughly to rub into the chilblains, night and morning, a small quantity of cod-liver oil emulsion. This will relieve the itching and throbbing, and within two or three days the condition will have cleared. A simple remedy, rather messy but very satisfactory.

LETTERS, NOTES, ETC.

Sir D'Arcy Power

Mr. W. R. LEFANU, Librarian, Royal College of Surgeons of England, writes from Downton Castle, Ludlow, Salop: With the approval of his son, Air Commodore Power, I am collecting material for a life of the late Sir D'Arcy Power. I shall be very grateful if any of your readers who possess letters from Sir D'Arcy will be kind enough to lend them to me for copying and immediate return.

Increase of Tuberculosis

Dr. A. ARNSTEIN (London, N.21) writes: In his letter on the increase of tuberculosis Dr. L. Roberts (February 7, p. 198) suggests a combined endogenous and exogenous origin of some cases of adult pulmonary tuberculosis, and questions whether this suggestion is new. May I follow his invitation and indicate my view by quoting a short paragraph translated from a paper of mine on "Bronchogenous Pulmonary Tuberculosis originating in Endogenous Lymphoglandular Reinfection in Old People" (*Wien. med. Wschr.*, 1936, No. 3): "Factors which may cause this type of tuberculosis are: (1) lowering of tuberculosis resistance caused by carcinoma, diabetes, senile cachexia; (2) exogenous superinfection which acts probably like 'tuberculinization' or by increase in allergy and thus reactivates old tuberculous foci; (3) massive exogenous reinfection, which is a theoretical possibility but is in reality very rare." On account of further observations (*vide* my paper in *Tubercle*, 1941, **22**, 281) I should like to add to point (1) that, in a number of cases, a certain degree of (non-industrial) pneumonoconiosis of the mediastinal and bronchial lymph glands may be responsible for the reactivation of an old tuberculous focus in these glands.

Operation in Advanced Old Age

Dr. T. E. COULSON, F.R.C.S.Ed., writes from Wincanton, Somerset: A resident of this town has lately died at the age of 98. On June 24, 1935, he was admitted to the Wincanton and East Somerset Memorial Hospital suffering from a strangulated umbilical hernia. He would at that time be aged 91. I operated immediately after admission, under a general anaesthetic. The hernia was a very large one, composed mostly of omentum with a number of adhesions. A small knuckle of strangulated but viable bowel was hidden at the bottom of this mass; this was released and returned to the abdomen. The operation was one of some difficulty owing to the masses of omentum and the number of adhesions, and took me about an hour to complete. He was discharged from hospital perfectly well on July 13, 1935.

A Home-made Artificial Breast

Prof. W. N. RAE, Sc.D. (Dublin) writes: Dr. Elsie Porter (February 14, p. 246) describes a home-made artificial breast using a Turkey sponge. I have made artificial breasts which have proved satisfactory in use from rubber sponges. These are generally rectangular in shape, and can be obtained in various sizes. With a pair of sharp scissors they can be clipped to have the same shape as the remaining breast, and are fitted into a pocket in the brassière.